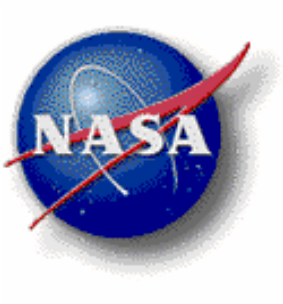
Human Research Program
Program Plan

June 1, 2006



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Human Research Program

Program Plan

May 31, 2006

Approved By:

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1. PART I: PROGRAM OVERVIEW

1.1 INTRODUCTION

The Human Research Program (HRP) was formed in September 2005 at the Johnson Space Center (JSC) in response to NASA's decision to move human research program management from Headquarters Exploration Systems Mission Directorate (ESMD) to JSC and to focus its research investment on investigating and mitigating the highest risks to astronaut health and performance in support of exploration missions. The HRP contains the biomedical research activities originating from the previous NASA Office of Biological and Physical Research (OBPR). The new integration and technology initiatives provide deliverables that specifically support NASA's exploration architecture. The HRP content is located at multiple NASA Centers that provide the Agency core competencies necessary for implementation of the Vision for Space Exploration. The participating NASA Centers have complementary core capabilities that address the needs of the HRP Elements (see 1.4.4). It is the intent of the HRP to integrate these core capabilities into the Program Elements to the maximum extent possible to ensure Program success. International agency cooperation in joint research and shared data is also a key aspect of the HRP.

1.2 PROGRAM GOALS, OBJECTIVES, AND METRICS

1.2.1 Goals and Objectives

The goal of the HRP is to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration. The specific objectives of the HRP are:

1. Develop capabilities, necessary countermeasures, and technologies in support of human space exploration, focusing on mitigating the highest risks to crew health and performance
2. Define and improve human spaceflight medical, environmental, and human factors standards
3. Develop technologies that serve to reduce medical and environmental risks, to reduce human systems resource requirements (mass, volume, power, data, etc.) and to ensure effective human-system integration across exploration systems
4. Ensure maintenance of Agency core competencies necessary to enable risk reduction in the following areas:
    a. Space medicine
    b. Physiological and behavioral effects of long duration spaceflight on the human body
    c. Space environmental effects, including radiation, on human health and performance
    d. Space human factors.

1.2.2 Metrics

HRP reviews of research activities and product development include the evaluation of program measures of success. HRP tracks the progress of each research activity to ensure timely inputs to the Office of the Chief Health and Medical Officer (OCHMO) space flight health standards and to support major Constellation program reviews including System Requirements Reviews (SRR) and Preliminary Design Reviews (PDR). The HRP, in conjunction with stakeholders, periodically reviews the status of countermeasures and products development to verify progress toward meeting the space flight health standards for exploration missions. HRP conducts yearly portfolio assessments and program implementation reviews at least every two years to ensure the research and development efforts remain relevant to the evolving Exploration needs, goals, and objectives.

Incremental progress is reported through normal status updates as defined in Section 3.13. Quarterly technical, cost, schedule, and risk reviews of each multi-center Program Element and its Projects are conducted at the Program level with representation from each participating Center as needed. The Program Manager also provides a Quarterly Status Review to the ESMD Associate Administrator (AA). Monthly Program Element assessments covering technical, cost, schedule, and risk are reviewed by HRP.

Current HRP efforts support the achievement of Government Performance and Results Act (GPRA) objectives including:

> Objective 8: Focus research and use of the International Space Station (ISS) on supporting space exploration goals, with emphasis on understanding how the space environment affects human health and capabilities, and developing countermeasures.
>
> > Outcome 8.5: Develop and test the following candidate countermeasures to ensure the health of humans traveling in space: Bisphosphonates, Potassium Citrate, and Midodrine
> >
> > Outcome 8.6: Reduce the uncertainties in estimating radiation risks by one half.

Annual inputs will be provided for inclusion in the GPRA and Program Assessment and Rating Tool (PART) in accordance with NPR 1080.1.

1.3 CUSTOMER AND STAKEHOLDER DEFINITION AND ADVOCACY

1.3.1 Customers and Stakeholders

There are three primary customers for the outcomes and products from the HRP Program. These are: (1) Exploration Systems Mission Directorate (ESMD), (2) OCHMO, and (3) the Space Operations Mission Directorate (SOMD).

The major stakeholders of HRP products are the Chief Health and Medical Officer, Flight Surgeons, the Astronaut Office, Flight Control Teams, Constellation Program, and spacecraft development project offices.

1.3.2 Customer and Stakeholder Advocacy

Customers and stakeholders must be active participants in the process of planning, reviewing, and assessing the direction and results of HRP activities. Frequent communications with the customer will ensure the projects remain relevant to Exploration needs and goals. The frequency and process for these communications are to be developed. Customers and stakeholders will provide inputs to the projects by reviewing the proposed standards, requirements, countermeasures, and systems solutions to ensure that products are usable, crew health is maintained, operating efficiency is improved, and vehicle and habitat designs are conducive to safe and efficient crew performance.

1.4 PROGRAM AUTHORITY AND MANAGEMENT STRUCTURE

1.4.1 Program Authority

The HRP Program Commitment Agreement (PCA) delegates management of the HRP to the Space Life Sciences Directorate at the Johnson Space Center (JSC). The Program structure is matrixed within the Directorate. The SLSD is responsible for providing the resources and personnel necessary to implement and manage the HRP within the approved scope and budget. The SLSD Director nominates the Program Manager who is then approved by the ESMD AA. Specific responsibilities for the Program Manager are delineated in paragraph 1.4.6.1. The governing Program Management Council (PMC) for this Program is the ESMD Directorate PMC (DPMC).

The ESMD has established an Advanced Capabilities Division (ACD) within the Directorate to provide the necessary advocacy, monitor program progress, and assure compliance of the HRP to Agency needs, goals, and objectives.

The Director for the ACD is responsible for developing opportunities for leveraging non-NASA HRP-related research to enhance mission requirements. The Director for the ACD is also responsible for assessing the applicability of internal and external research and technology development activities to address ESMD requirements.

The list of principal program documents for the HRP and associated responsibilities are presented in Table 1-1.

1.4.2 Human Research Program Management Structure

The overall reporting and management structure for the multi-center HRP is shown in Figure 1-1. The HRP Program Manager reports directly to the ESMD AA or designee. Figure 1-1 also depicts the program control board for the HRP (HRP Control Board).

Table 1-1: Human Research Program Documentation Control

Document	Preparer	Approver	Concurrence	Configuration Management
Program Plan	Program Integration Manager	AA ESMD, Program Manager		ESMD Program Management Council
Program Budget	Program Integration Manager	AA ESMD, Program Manager	Element Managers	HRP Control Board
Program Integrated Master Schedule	Program Integration Manager	Program Manager	Element Managers	HRP Control Board
Program Requirements Document	Program Integration Manager	Program Manager	Element Managers	HRP Control Board
Science Management Plan	Deputy Program Scientist	Program Manager	Element Managers	HRP Control Board
Program Annual Report	Deputy Program Scientist	Program Manager	Element Managers	HRP Control Board

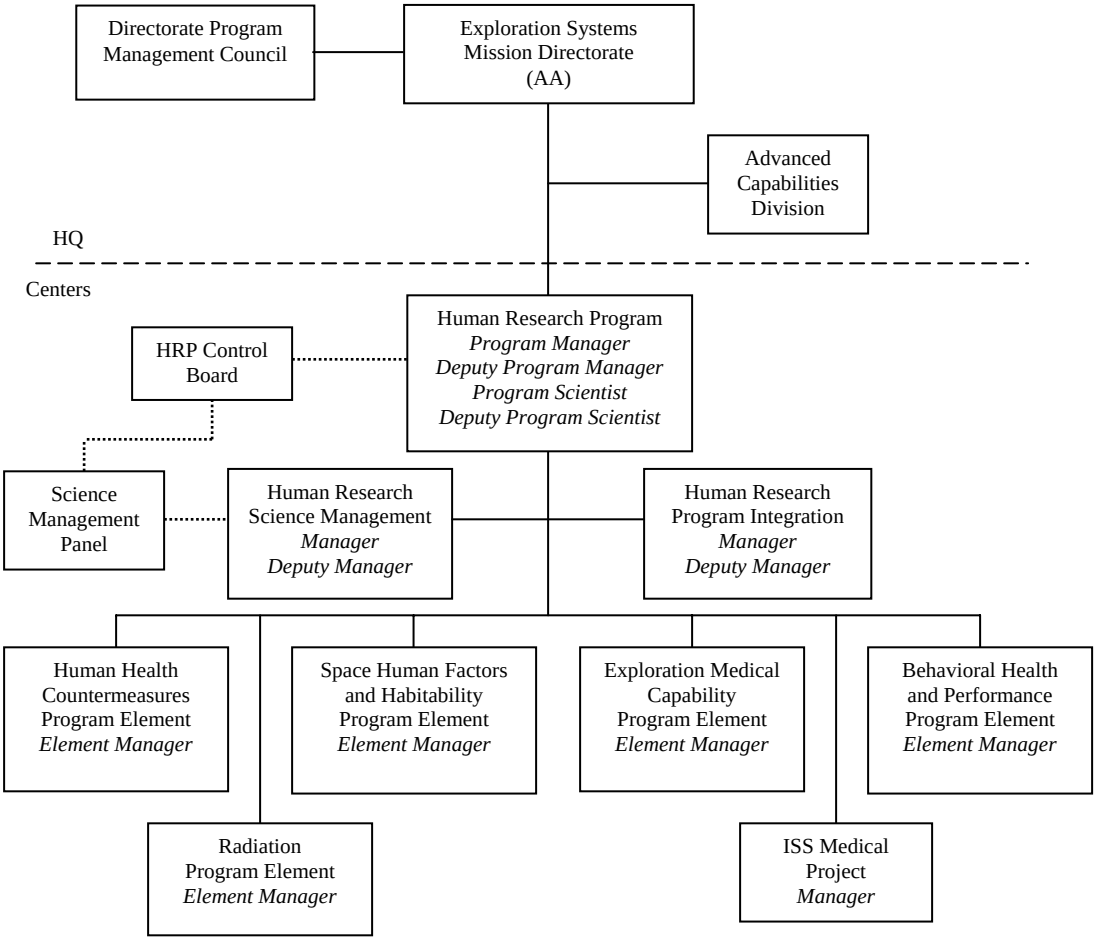


Figure 1-1: Human Research Program Management Structure

1.4.3 Program Work Breakdown Structure

The top-level Work Breakdown Structure (WBS) for the HRP is shown in Figure 1-2. The complete WBS is presented in Appendix C.

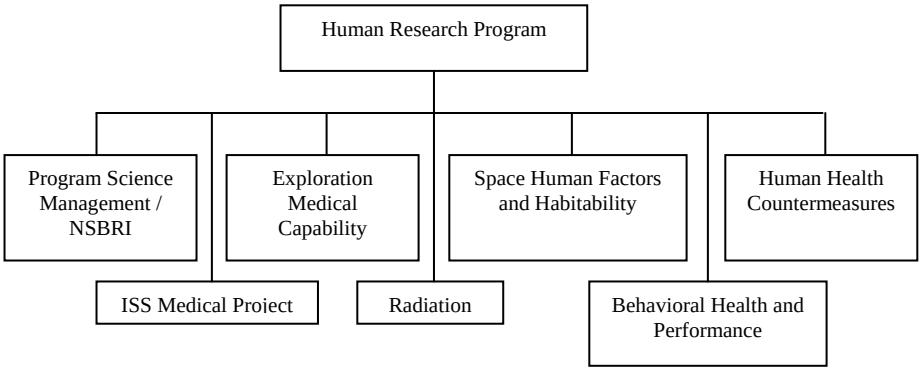


Figure 1-2: Human Research Program Work Breakdown Structure

With the exception of the Program Science Management / NSBRI WBS, each WBS item corresponds to a Program Element described in 1.4.4. The tasks within the Program Science Management / NSBRI WBS are described in 1.4.5.

1.4.4 Program Elements and Projects

The program is divided into six (6) major elements, described in the following subsections. An element consists of the aggregation of related projects and research tasks focused toward developing products that reduce risks to the crew. These risks include physiological and psychological health and performance degradation experienced in the hazardous environment of space and in the isolation of exploration missions.

A project is characterized as an integrated set of tasks undertaken to deliver a product or set of products to a designated customer on a specified date. Project Managers and staff develop project plans per the template defined in NPR 7120.5 that define their specific goals, objectives, schedules, deliverables, and other project-specific information.

1.4.4.1 Radiation Element

The Radiation Element performs investigations to assure the crews can safely live and work in the space radiation environment without exceeding the acceptable accumulation limits during and after the missions.

The major deliverables for the Radiation Element include inputs to standards for radiation health, habitability, and environments; requirements for radiation protection, early technology development for monitoring equipment, caution and warning, models and tools to assess and predict risks due to space radiation exposure, and strategies to mitigate exposure effects.

Although information exists to recommend crew exposure limits and spacecraft design requirements for missions in low earth orbit, there is insufficient knowledge of the health effects of radiation, the space radiation environment, and countermeasure efficacy to provide recommendations on crew exposure limits and design requirements for extended lunar and Mars missions. Therefore, a major focus of the Radiation Element will be basic and fundamental research to expand the knowledge base and reduce the uncertainty inherent in current exposure limits and design requirements.

The Radiation Element is a multi-center project led by JSC, and includes the work at the Langley Research Center (LaRC) and the Ames Research Center (ARC). The intramural and extramural groups use national laboratories to conduct research using accelerator-based simulation of space radiation.

1.4.4.2 Behavioral Health and Performance (BHP) Element

The BHP Element identifies and characterizes the behavioral and performance risks associated with training, living and working in space, and return to Earth. The BHP Element develops strategies, tools, and technologies to mitigate these risks.

One set of deliverables for the BHP Element consists of input to the BHP health and medical standards, requirements, and operational tools for exploration. A second set of deliverables consists of knowledge, tools, and technology to prevent performance degradation, human errors or failures during critical operations resulting from sleep loss, circadian de-synchronization, fatigue or work overload; deterioration of morale and motivation; interpersonal conflicts or lack of team cohesion, coordination, and communication; team and individual decision-making, performance readiness factors (fatigue, cognition, and emotional readiness); behavioral health disorders; and individual selection and crew assignments.

The lead center for this work is JSC in close collaboration with ARC. ARC provides special expertise in the following areas:

- sleep and fatigue, cognition, team performance and decision-making, and technology for assessing these factors
- development and validation of biomarkers (e.g., non-intrusive physiological measures) for predicting performance and behavioral health degradations
- tests of assessment and mitigation strategies in operational analog spaceflight environments.

The BHP Element also works in close collaboration with its National Space Biomedical Research Institute (NSBRI) partners. The Neurobehavioral and Psychosocial Adaptation Team and the Sleep and Chronobiology Team have expertise in predictive modeling, and the development and testing of BHP-related countermeasures and technologies for monitoring and assessing crew performance and health status.

1.4.4.3 Exploration Medical Capability (ExMC) Element

The Exploration Medical Capability Element is responsible for defining requirements for crew health maintenance during Exploration missions, developing treatment scenarios, extrapolating from the scenarios to health management modalities and evaluating the feasibility of those modalities for use during Exploration missions. The ExMC Element is also responsible for the evolution of Exploration health care options based on past experience, anticipated needs, and input from flight surgeon and crew offices.

The Vision for Space Exploration objectives present significant new challenges to crew health care capabilities. These challenges include the hazards created by the terrain of lunar or planetary surfaces that may be difficult to traverse during exploration, the effects of gravity transitions, low gravity environments, and limited communications with ground-based personnel for diagnosis and consultation. Each challenge has associated medical implications and medical requirements and technologies to ensure safety and success.

The major deliverables for the ExMC Element consist of input to the following standards and requirements:

- medical standards of care
- crew selection and retention criteria
- fitness for duty criteria
- requirements for medical equipment, clinical care capabilities, medical equipment technology development
- medical informatics
- integrated medical requirements for each mission.

This effort is led by JSC. The Glenn Research Center (GRC) and ARC contribute technology development and clinical care expertise to the ExMC Element.

1.4.4.4 Space Human Factors and Habitability Element

The Space Human Factors and Habitability Element consists of three main project areas: 1) Space Human Factors Engineering; 2) Advanced Environmental Health and 3) Advanced Food Technology. The major deliverables for the space human factors engineering projects are validated models for predicting the effects of interface designs on human performance; methods for measuring human and human-system performance; design concepts for and evaluations of advanced crew interfaces and habitability systems; and requirements for spacecraft and space missions.

Research and development activities in space human factors engineering address challenges that are fundamental to design and development of the next generation crewed space vehicles. These challenges include: 1) understanding human physical and cognitive capabilities for individuals and teams in the context of the space environment and engineering system design, 2) understanding the requirements for information feedback to the crew and developing technologies to ensure these requirements are met, and 3) building tasks and tools that are compatible with humans and that enable human performance consistent with mission success.

The lead center for this work is JSC, in close collaboration with ARC. ARC provides special expertise in perception, cognition, automation and display design and evaluation, and individual and team performance, complementing JSC's expertise in habitability and ergonomics.

The major deliverables for the advanced environmental health projects are inputs to environmental health standards and requirements for Exploration spacecraft and habitats. Advanced Environmental Health research assesses the acute and long-term health impacts of targeted pollutants in the environment, including lunar dust, microorganisms, and atmospheric contaminants. Advanced environmental monitoring tasks apply the latest technologies to identification, quantification, and location of significant environmental risks. The lead Center for this work is JSC in close collaboration with ARC and the Exploration Technology Development Program (ETDP) led by LaRC. ARC provides special expertise in pulmonary diseases and selected aspects of dust activation. EDTP provides lunar dust simulants as precursor material for testing with actual lunar dust. EDTP also funds development and flight demonstration of environmental monitoring hardware to address high risk environmental hazards.

The deliverables for the advanced food technology projects are extended shelf life foods with improved nutritional content and quality and reduced packaging mass to provide easier trash management. The advanced food research effort provides a safe, nutritious, and acceptable food system to maintain crew health and performance. Technology development addresses nutritional, psychological, safety, and acceptability requirements while minimizing mass, volume, waste, power, and trace gas emissions.

1.4.4.5 Human Health Countermeasures (HHC) Element

The HHC Element provides the biomedical expertise for the development and assessment of medical standards, vehicle and spacesuit requirements dictated by human physiological needs and develops a validated and integrated suite of countermeasures for exploration missions that ensure the maintenance of crew health during all phases of the mission.

Countermeasures target human physiology and performance capabilities at risk from space flight missions at each stage of mission performance. Pre-flight countermeasures involve crew selection, physical fitness and exercise, physiological adaptation training, and health stabilization. In-flight countermeasures cover physiological and nutritional health, physical fitness, and mission performance. Post-flight countermeasures target rehabilitation strategies.

The major deliverables for the HHC Element are input for the refinement of health and medical standards, validated human health prescriptions, validated exercise system requirements, extravehicular activity (EVA) pre-breathe protocols, integrated physiological countermeasures, partial gravity human performance predictions and requirements, and criteria for the agency fitness for duty and crew selection/retention standards. Core Laboratories provide the biomedical expertise that enables the development of medical standards, the assessment of the risks to crew health and performance, and the validation of countermeasures.

This effort is led by JSC. Other participants in this work include ARC and GRC. International agencies currently cooperate on joint flight proposals, reduced gravity studies, and collaborative bedrest studies. It is anticipated that such collaborations will continue in the future.

1.4.4.6 ISS Medical Project (ISSMP) Element

The ISSMP Element within the HRP provides planning, integration, and implementation services for HRP research tasks and evaluation activities requiring access to space or related flight resources on the ISS, Shuttle, Soyuz, Progress, or other spaceflight vehicles and platforms. This includes support to related pre-flight and post-flight activities.

ISSMP services include operations and sustaining engineering for HRP flight hardware; experiment integration and operation, including individual research tasks and on-orbit validation of next generation on-orbit equipment; medical operations; procedures; and crew training concepts, as well as operation and sustaining engineering for the Telescience Support Center, which provides real-time operations and data services to all HRP flight experiments. This Element function integrates HRP-approved flight activity complement and interfaces with external implementing organizations, such as the ISS Payloads Office and International Partners, to accomplish the HRP's objectives. This effort is led by JSC with Baseline Data Collection support from the Kennedy Space Center (KSC).

1.4.5 Program Science Management / NSBRI WBS Element

In addition to the program elements and projects, the program management, integration, and science management offices, in conjunction with the NSBRI, provide key coordination activities within the Program. Program Management offices include the Program Office, the Program Integration Office (PIO), and the Science Management Office (SMO). These functions, along with NSBRI activities, cover all aspects of managing the program and projects.

1.4.5.1 Program Management

Program Management covers the HRP Program Management Office personnel and operations, including the Program Manager and Deputy Program Manager. It covers coordination with other NASA programs, coordination with participating NASA Centers, coordination with the NSBRI, and communications with the ESMD/ACD, OCHMO, and SOMD offices at Headquarters.

1.4.5.2 Program Integration

Responsibility for specific program integration efforts is delegated to the HRP PIO. The PIO ensures close coordination of exploration customer needs and program deliverables to meet those needs. The HRP PIO is responsible for program planning, integration, and coordination in support of the HRP Program Manager. The PIO shall:

a. Develop and maintain the HRP baseline technical requirements, with allocations to the element level.
b. Develop and maintain the baseline HRP budget and schedule. PIO leads budget formulation and integration and will integrate program input to the annual ESMD Planning, Programming, Budgeting, and Execution (PPBE) process.
c. Lead the acquisition process for procurement of program support tasks, including procurement and grants management. Note this does not include the selection of science through NASA Research Announcements (NRA), Announcements of Opportunity (AO), Broad Agency Announcements (BAA), etc. for the Program. See 1.4.5.3.

d. Coordinate and integrate HRP program-level reports. PIO will synthesize reporting products for delivery to external stakeholders in their required format.
e. Ensure HRP product and process quality control by developing and tracking execution of HRP internal processes and facilitating process improvement activities.
f. Establish and lead or coordinate technical and programmatic trade studies that involve more than one HRP element. This effort may involve coordination of key inter-program responses.
g. Develop tools and analyses of the program portfolio to assure proper balance of content and priorities.
h. Collect and assess the integrated programmatic risk posture for HRP. PIO will assure thorough risk assessment is conducted for all program activities and provide recommendations for elevating and rating of program risks.
i. Provide a formal conduit to the Constellation Program through the SLSD Exploration Systems Integration Office, transmitting key information to HRP and collecting HRP assessments of Constellation products. The PIO will track and manage assessments of documents and design packages performed within the HRP for delivery to Constellation programs and projects.
j. Facilitate standards synthesis, vetting, and approval. PIO will organize and facilitate generation and approval of technical standards, including establishment of processes, tracking progress, and working issues.
k. Seek out, and formally establish, collaborative activities that either reinforce HRP core competencies or develop products that help HRP meet its goals and objectives. This includes the coordination of Program Level Internal Task Agreements (ITA).
l. Establish and manage the process for selecting technologies and maturing those technologies to higher Technology Readiness Levels (TRL).

To ensure quality HRP processes, the PIO will develop or manage the following documents and databases related to its responsibilities:

1. HRP Program Plan (and Program Risk Management Plan in Appendix E)
2. Program Baseline:
    a. HRP Program Requirements Document
    b. HRP Budget Database
    c. Integrated Master Schedule
    d. HRP Deliverables Database
    e. HRP Risk Database
3. HRP Annual PPBE Submittal Package
4. HRP Annual Report
5. Lessons learned database.

1.4.5.3 Science Management

Responsibility for HRP science management, planning, and coordination is delegated to the HRP SMO. The HRP SMO is managed by the Program Scientist and coordinates and performs the following tasks:

a. Ensure identification and prioritization of the research objectives that reduce the operationally relevant human health and performance risks associated with the Vision for Space Exploration and NASA's Exploration program. The prioritized research needs, goals, and objectives shall be documented in an Integrated Research Plan. The plan shall guide the allocation of the HRP resources to manage the portfolio. The portfolio content includes NASA and the NSBRI ground and flight research.

b. Establish HRP science management policy including appropriate standards for obtaining scientific evidence. The HRP SMO shall insure that the integrated research portfolio is properly designed, that measurement techniques are consistent with contemporary standards, and that scientific integrity is maintained via rigorous external community reviews and internal program reviews throughout the life of the program. The HRP SMO shall develop and evaluate criteria, including termination criteria, for the review of on-going research.

c. Assure that acquisition approaches achieve appropriate results consistent with programmatic resources and schedules. The HRP SMO shall advocate for competitive selection whenever appropriate and help recruit and retain the highest quality investigators to participate in competitive solicitations, directed studies, and review panels. The NSBRI solicitation processes and investigator recruitment is essential to the process, including assurance that NSBRI research objectives are aligned with HRP goals and objectives, and shall be described in the Integrated Research Plan.

d. Support the development of external relationships with domestic and international agencies to help achieve the research goals and objectives of the program. Domestic agencies include other U.S. Government agencies, academic institutions, and commercial entities.

Science management activities shall comply with NPR 1080.1.

The HRP SMO shall develop and implement a Science Management Plan and an Integrated Research Plan.

1.4.5.3.1 HRP Science Management Plan

The HRP Science Management Plan shall include:

a. Science management organizational structure including the Science Management Panel
b. Science Management Office roles and responsibilities
c. Science management interfaces
d. Peer and Non-Advocate Review processes
e. A Conflict of Interest policy that delineates appropriate procedures for dealing with conflicts of interest throughout the HRP

f. The process for maintaining an archive of relevant data
g. The criteria and processes for closure of risks in the Bioastronautics Roadmap
h. A process for managing solicitation and selection reviews and providing recommendations on task/investigation selection, specifically for developing and maintaining a structured science program that encompasses grants, in-house, academic, institute, participating NASA Centers, international participants, and contracted efforts
i. A process for assessing the need for continuation, modification, or termination of scientific studies and experiments based on results and evolving needs of the HRP
j. Processes for conducting annual forum(s) for enhanced visibility into scientific progress and communicating results to stakeholders (space medicine, astronauts, managers, and public) and customers (ESMD, SOMD, OCHMO)
k. Criteria for evaluation of the results of HRP research in terms of risk mitigation and operational relevance
l. Methods for communication of research results and relevancy to the operations community.

1.4.5.3.2 HRP Integrated Research Plan

The HRP Integrated Research Plan shall contain the prioritized set of research and technology development activities that minimize the human health risks for specific exploration missions showing dependencies such as research requiring the ISS.

1.4.6 Key Personnel Roles and Responsibilities

1.4.6.1 Human Research Program Manager

The HRP Program Manager is accountable to the ESMD AA for the performance of the Program against the established ESMD objectives. The Program Manager is responsible for Program safety, security, cost, schedule, technical performance, and risk. The HRP Program Manager is also responsible for integration, oversight, and assistance to the program's constituent Program Elements. The HRP Program Manager coordinates program content with the ESMD, provides leadership, and is responsible for the successful accomplishment of the program that meets the needs of the customers. The Program Manager recommends to the ESMD the establishment or termination of program elements.

In addition to the responsibilities defined in NPR 7120.5, the Program Manager shall:

a. Manage and implement the Human Research Program, including activities performed at participating NASA centers
b. Support ESMD/ACD by providing necessary program support to strategic management functions
c. Integrate program planning and direction including the program schedule
d. Develop the Program budget
e. Allocate and manage Program resources
f. Manage and implement Program outreach activities

g. Approve Projects in consultation with ESMD.
h. Manage research, including investigation selection and termination in consultation with ESMD, and NRA/AO development
i. Implement international agreements
j. Implement ISS human research, including flight assignment/manifesting, and payload certification for flight
k. Implement Program metrics assessments and reporting
l. Ensure timely and effective grants management per the NPR 5800.1
m. Implement intergovernmental agreements such as those with the National Institute of Health (NIH) and the U.S. Department of Energy (DoE)
n. Implement a Risk Management process. (See section 3.8.)
o. Coordinate Human Research Program center-level implementation activities with supporting center management
p. Generate an annual assessment of HRP progress in meeting metrics, delivering products, and risk mitigation and closure
q. Assure communication of HRP results and their relevancy to the operations community.

1.4.6.2 Program Scientist

Human research science management shall be led by the Human Research Program Scientist. The HRP Program Scientist will be the primary interface for external HRP science management activities with NASA Headquarters (HQ), collaborating institutions, and other program-related outreach pursuits. The Program Scientist shall:

a. Support Exploration Systems Mission Directorate activities and serve as a resource in NASA-wide activities related to human research
b. Identify and cultivate strategic partnerships to leverage HRP capabilities in support of the Vision for Space Exploration
c. Work with other domestic and international agencies to assure effective integration between NASA Human Research Projects and those of our counterparts
d. Prepare and present scientific content to governmental entities, Congress (members and staff), and others as appropriate
e. Work with the NSBRI through the cooperative agreement to ensure the NSBRI portfolio supports, and is complementary to, the HRP portfolio (shared with Deputy Program Scientist)
f. Serve as Alternate COTR for NSBRI cooperative agreement
g. Participate in program reviews; provide program management feedback on the effectiveness of the programs, and recommend improvements (shared with Deputy Program Scientist)
h. Interface with the Directorate on strategic and long-range planning
i. Consult with Deputy Program Scientist on matters as needed.

j. Serve as Alternate Chair of the Science Management Panel (see 3.1.3.2)

k. Serves as HRP representative to International Space Life Sciences Working Group (ISLSWG), and, when necessary, provides input to the International Space Station User Operation Panel, the International Space Station Multilateral Coordination Board, HOA agreements, etc. Assists SLSD Chief Scientist as lead NASA representative to ISLSWG

1.4.6.3 Deputy Program Scientist

The HRP Deputy Program Scientist will be the primary interface for internal HRP science management activities across the program elements and projects. The Deputy Program Scientist shall:

a. Chair the Science Management Panel (see 3.1.3.2)

b. Ensure integration and prioritization of HRP science content and all activities relating to human research, including providing the primary pathway for interactions between the Program Manager and the Program Elements on issues involving scientific and technical research and development

c. Conduct annual assessments of the Program portfolio and provide recommended modifications to the Program in support of the PPBE submittal

d. Direct the development and implementation of the Science Management Plan and the Integrated Research Plan

e. Develop and guide HRP scientific research and technology processes

f. Oversee the solicitation and selection process for HRP-funded research at NASA Centers, the Jet Propulsion Laboratory, universities, other government agencies, and private and non-profit institutions (assisted by Program Scientist)

g. Work with the NSBRI through the cooperative agreement to ensure the NSBRI portfolio supports, and is complementary to, the HRP portfolio (shared with Program Scientist)

h. Participate in program reviews; provide program management feedback on the effectiveness of the programs, and recommend improvements (shared with Program Scientist)

i. Consult with Program Scientist on matters as needed.

1.4.6.4 Program Integration Manager

The Program Integration Manager manages the PIO and leads all program integration functions described in Section 1.4.5.2. The Program Integration Manager is responsible for the internal coordination of HRP deliverables to external customers and stakeholders. The Program Integration Manager is also responsible for the integration of program activities involving multiple program elements. The Program Integration Manager shall:

a) Ensure program level documents and processes are developed, maintained, and implemented

b) Coordinate and integrate HRP products to be provided to external customers and stakeholders

c) Ensure cross element coordination and integration occurs for activities involving multiple elements

d) Lead the development of the annual HRP PPBE package in support of the Program Manager's submittal

e) Ensure that the HRP Integrated Schedule is developed and maintained

f) Ensure that the HRP Risk Management Plan is implemented.

1.4.6.5 Program Element Manager

The HRP Program Manager delegates the implementation, management, and oversight of the constituent Projects to the Program Element Managers. The Program Element Manager shall:

a. Manage the technical content, including projects within the Element based on the requirements, resources, goals and objectives, and direction provided by the Program Manager
b. Provide technical, cost, and schedule status reports at the Element level
c. Coordinate Element activities across the Agency
d. Provide recommendations for scientific content to Program Scientist
e. Recommend updates to the Bioastronautics Roadmap
f. Maintain communication with other Elements to insure solutions are integrated between projects
g. Provide direction to the Project Managers as needed
h. Be accountable to the HRP Program Manager for the performance and integration of all activities within the Element, including status on projects and tasks
i. Develop and manage inter-center agreements for element projects' support and tasks
j. Manage the implementation of international agreements and other Agency-approved agreements and provide technical support for the development of these agreements
k. Participate in HRP risk management process
l. Provide appropriate schedules that roll up tasks and project schedules which feed key milestones in the Program Integrated Master Schedule.

1.4.6.6 Principal Coordinating Scientist

Principal Coordinating Scientists will be located in the Program Elements and shall:

a. Manage and prioritize the science content at the discipline level to ensure continuity, cohesiveness, and comprehensiveness in all activities
b. Provide recommendations on the solicitation and selection of human research funded within their disciplines
c. Support Program Science management in the implementation of their responsibilities.

1.4.6.7 Project Manager

The Project Manager is responsible for implementing project activities in accordance with the provided objectives within the cost, schedule, and resources. The Project Manager shall:

a. Implement the assigned projects within budget, schedule, and content guidelines
b. Develop project plans, work breakdown structures, level III budgets and schedules, make or buy decisions, statements of work, and requests for proposal
c. Implement and manage program-approved inter-center task agreements
d. Manage definition, design, development, integration, test, launch, operations
e. Report status to the Element Manager in a timely manner
f. Manage project reserves
g. Develop and implement project risk mitigation plans and support program risk management processes
h. Conduct technical cost/schedule tradeoffs
i. Inform the Element Manager of deviations to the schedule, budget, and content
j. Develop and implement project-related inter-center agreements
k. Maintain a project-level schedule that feeds key milestones to the integrated Program schedule.

1.4.6.8 Project Scientist

The Project Scientist provides the general scientific interpretation and oversight of the Project direction as it relates to the Program goals and objectives and Agency goals. The Project Scientist shall:

a. Provide recommendations for scientific content of the Project
b. Recommend updates to the Bioastronautics Roadmap
c. Provide strategic and tactical scientific direction for the project.
d. Identify gaps and assess project progress towards meeting project needs, goals, objectives, and deliverables.
e. Monitor and/or coordinate applicable research tasks, both within the participating Centers and outside the participating Centers to the level required
f. Work with the Project Manager to ensure that the science activities are synchronized with the project schedule, costs and milestones.

2 PART II: PROGRAM BASELINE

2.1 PROGRAM REQUIREMENTS

The HRP, in consultation with customers and stakeholders, shall determine areas of specific focus and shall be responsive to OCHMO, SOMD, and ESMD needs, goals, and objectives for maintaining crew health and performance during exploration missions. ESMD and Constellation documents provide the mission architecture definitions, mission concepts of operations, vehicle, habitat, and space suit performance requirements, and other technical information needed to focus the HRP efforts for specific exploration missions. See Figure 2-1. As ESMD needs, goals, and objectives evolve over the life of the exploration program, the content of the HRP shall be adjusted to best support the changes.

The HRP shall conduct research, develop countermeasures, and undertake technology development to inform and support compliance with NASA's health, medical, human performance, and environmental standards. HRP research and technology development shall result in:

- Identification and quantification of the risks associated with human spaceflight for the various exploration missions
- Delivery of data to support development of, and updates to, applicable human health and performance standards for the various exploration missions
- Development of countermeasures to provide mission planners and system developers with strategies for mitigating crew health and performance risks
- Development of technologies to provide mission planners and system developers with strategies for monitoring and mitigating crew health and performance risks
- Maintenance of NASA's core competency in space life sciences.

The research portfolio shall be guided by the identification of the highest risks to human health and performance. The HRP shall use the Bioastronautics Roadmap (NASA / SP-2004-6113) as a reference for prioritization of crew health and performance risks. The Bioastronautics Roadmap defines and categorizes the specific science discipline risks that affect human exploration missions.

The technology development portfolio shall be focused on providing in-space capabilities for countermeasures and clinical care commensurate with the required medical standards of care for specific mission scenarios.

The HRP shall identify and manage programmatic and crew health and performance risks in accordance with NPR 8000.4 and the ESMD Risk Management Plan.

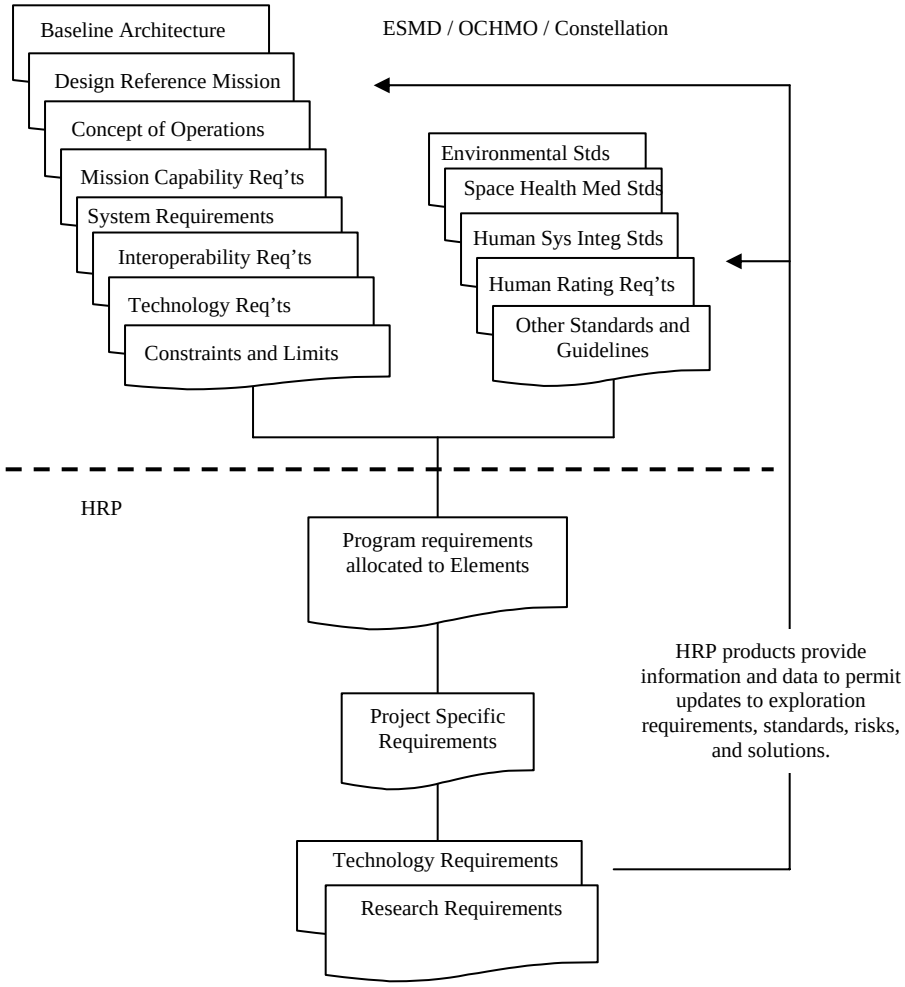


Figure 2-1: HRP Requirements Flow

2.2 PROGRAM SCHEDULE

The Master Schedule for the HRP is defined in the HRP PCA and reflected in Appendix D. The HRP Master Schedule is a roll-up of significant Element and Project activities. The major milestones for the Program shall be baselined as necessary to support Constellation program milestones. The schedule shall be assessed monthly and updated as required. On-going support activities not shown in Appendix D, including Flight Analog Research Center, ISS Medical Project, and Lunar Testbed capabilities are captured in the detailed integrated program schedule.

2.3 PROGRAM RESOURCES

The resources funded for conduct of the HRP are defined in the HRP PCA. The HRP shall make formal recommendations to ESMD to establish resource commitments with annual updates as part of the PPBE process defined in NPR 7120.5 and NPD 1000.0. The HRP Program Manager coordinates Center-level resources with the Center Director through the PPBE process. This is endorsement is also established through the PPBE process.

The HRP shall manage program resources to maintain focus on Program goals and objectives and to control program costs. The HRP shall implement a budget control process to support agency full cost accounting objectives. The HRP Program Manager shall hold 85% of the Allowance for Programmatic Adjustment (APA) for the Program.

The budgets for each Field Center cover the full cost of the assigned responsibilities from HRP and include ground-based research and technology endeavors and flight definition, implementation, and operations activities. Budget agreements shall be documented using Internal Task Agreements (ITAs). Changes to budgets shall be tracked and authorized using Budget Change Directives (BCD).

3 PART III: SUBPLANS

3.1 CONTROLS AND COMPLIANCE

At the discretion of the Program Manager, the HRP shall use existing SLSD processes and tools for the management and control of the Program. This will maintain operating efficiency and reduce costs.

The Program Office will monitor changes affecting the HRP that warrant modifications to the PCA. The Program Manager will support the ESMD AA in preparing PCA modifications and documenting them in the PCA change log, as required. The Mission Directorate AA will coordinate approval of the modified PCA.

3.1.1 Requirements Monitoring and Control

Requirements from a number of sources drive the content and direction of the HRP. The HRP Program Manager is responsible for ensuring that requirements monitoring and change control activities are consistent with agency policies, practices and procedures, and support ESMD needs, goals, and objectives.

Program Reviews shall be conducted as defined in section 3.13 to ensure that program goals and objectives, as well as research and development activities, remain consistent with current ESMD research and mission needs. Each activity shall be reviewed to assess the status and continuing relevance of HRP content against the evolving ESMD research and mission requirements. These reviews may result in adjustments to HRP content to align it with updated ESMD research and technology development requirements.

The results of the research conducted within the HRP, as well as evolving exploration requirements and mission definitions, may identify the need for a new project, or projects, to further understand and mitigate the effects and risks associated with human spaceflight. The HRP shall work with the ESMD and stakeholders to define fully the scope of these projects, to obtain funding for the projects, and to gain authorization to proceed.

3.1.2 Program Configuration Management

Configuration management of program-level documents, milestones, and project plans shall be in accordance with the Space Life Sciences Directorate Configuration Control Management Plan, JSC 28330. Configuration of these items shall be controlled through the Human Research Program Control Board (HRPCB). Configuration control of project implementation documents, schedules and products is delegated to the JSC/SLSD Division Configuration Control Boards (CCBs).

3.1.3 Configuration Control Boards

The HRP shall use a series of Boards to provide configuration management and review of HRP content. Primary control shall be through the HRPCB.

3.1.3.1 Human Research Program Control Board (HRPCB)

The HRPCB shall serve as the configuration management and decision-making forum for the Human Research Program. The HRPCB shall provide the forum for approval of the HRP technical, management, operations, user and integration requirements, science priorities, as well as Program schedules and resources. Detailed responsibilities and duties are defined in the HRPCB charter.

The HRPCB shall use the JSC/SLSD Division CCBs for controlling HRP Program Element implementation level activities. The relationship between the HRPCB and the Division Control Boards within JSC/SLSD are shown in Figure 3-1.

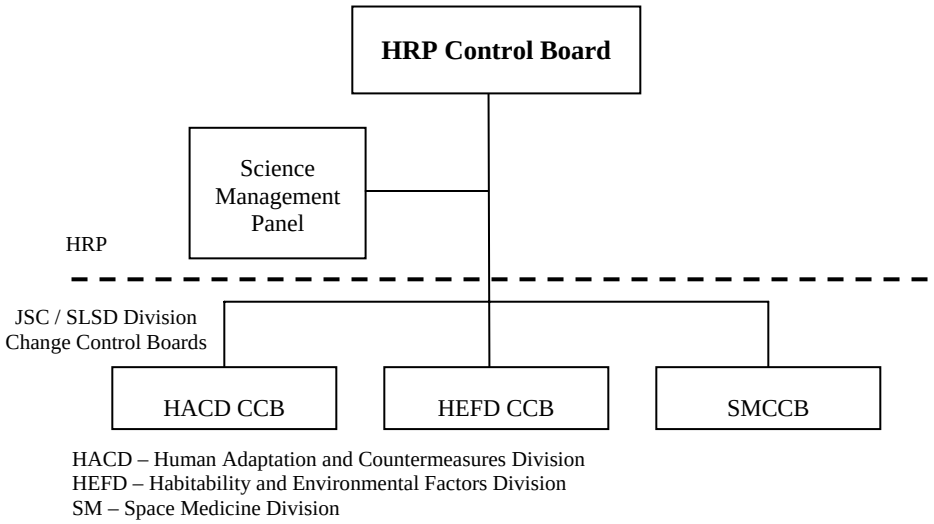


Figure 3-1: Control Boards for the HRP

3.1.3.2 Science Management Panel

The Science Management Panel (SMP) is the HRPCB-chartered forum, chaired by the HRP Deputy Program Scientist (SMO Deputy Manager), used to facilitate the science management function described in 1.4.5.3. The HRP SMP shall:

- Develop the HRP integrated portfolio and present the proposed portfolio to the HRPCB for approval
- Strategically integrate program element science priorities, objectives, activities, and outcomes across the Human Research Program, focusing on science products and deliverables that are operationally relevant
- Assure HRP science and technology activities reduce Exploration Mission risks

- Assure cross-discipline coordination of countermeasure development and validation
- Prioritize HRP science and technology activities across program elements and limited resources (e.g., flight, and ground analogs)
- Ensure that an integrated science program is developed and maintained, including grants, in-house, academic, institute, other NASA Centers, international collaborators, and contracted efforts
- Ensure projects adhere to the HRP science management plans and processes.

The SMP is supported as necessary by the participating Centers. Detailed responsibilities and duties are defined in the Science Management Panel Charter.

3.1.3.3 Division Configuration Control Boards

The Division Configuration Control Boards maintain configuration control and quality management oversight for HRP Element and Project activities assigned to the Division as described in the SLSD Configuration Control Management Plan. These CCBs shall provide configuration control processes and support for baseline documentation, sponsored studies, and other deliverables as appropriate.

3.1.4 Cost and Schedule Controls

The HRP shall use regular cost and schedule reporting, as coordinated through the PIO, to measure performance of the Elements and Projects against the program baseline. Individual Elements and Projects shall report status at periodic technical, cost, and schedule reviews (TCSR) and via Monthly Activity Reports (MAR). This material shall be reviewed and assessed by the PIO and a summary shall be submitted to the Program Manager. Project content and schedules shall be adjusted accordingly to maintain Program cost and schedule objectives. The HRP shall use BCD's to re-allocate funding at the element and project levels. Changes to major project milestones must be approved by the HRP Program Manager.

3.1.5 Communications Plan

The primary communications paths for the HRP are depicted in Figure 3-2.

3.1.5.1 Formal Communications

All formal program communications with the ESMD, Constellation, the OCHMO, and SOMD shall be controlled through the HRP Program Office (including the PIO and the HRP SMO) and shall be approved by the Program Manager or designee. This includes all management and technical information related to the technical, cost, schedule, and risk performance of the HRP. Specific individuals shall be identified as Points of Contact to coordinate communications with ESMD, Constellation, OCHMO, and SOMD.

The Program Office shall establish mechanisms for flowing directions, information, and requirements to and from the above external organizations to the points of contact within the Elements and Projects as necessary.

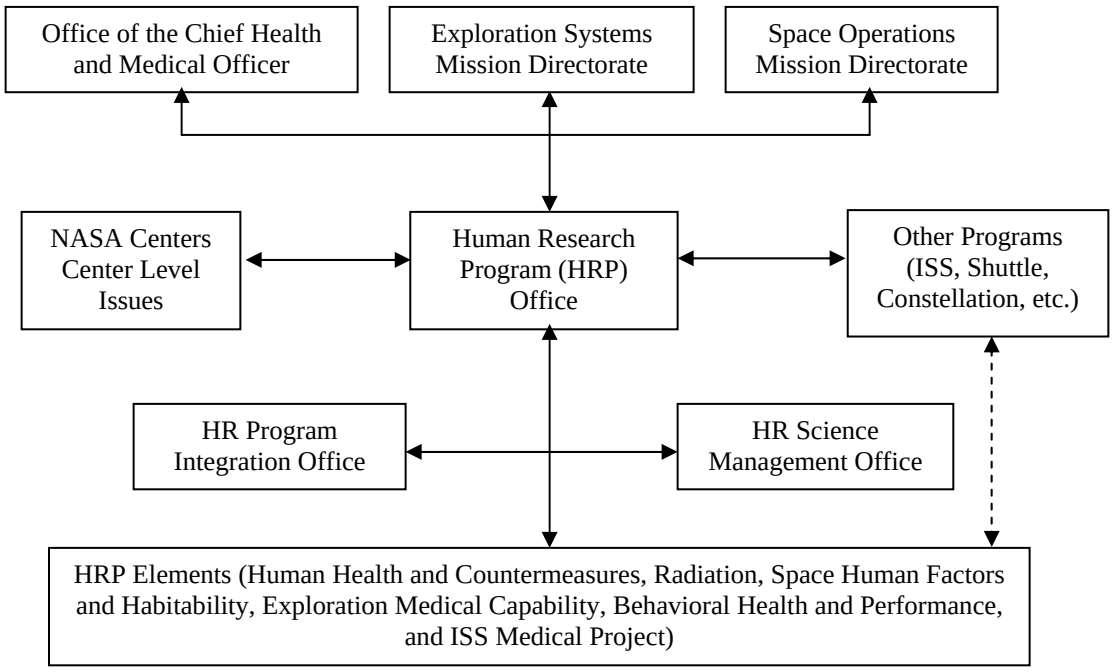


Figure 3-2: HRP Communication Paths

3.1.5.2 Informal Communications

The Program Elements and Offices shall facilitate communication between elements, projects, and tasks to ensure HRP objectives are met. This communication will provide a smooth integration of the output from the various research and development activities. The Program Elements and Offices shall control all day-to-day communication with internal and external researchers and support organizations with respect to meeting program objectives. These include Principal Investigators, research facilities, academia, international support teams, NSBRI, supporting NASA Centers, ESMD Strategic Communications Office, and other research organizations as well as other program offices. The HRP shall establish and maintain regular periodic communications forums to facilitate integration and product development. These forums shall publish plans and results and provide access to the necessary constituents.

Any issues that may affect cost or schedule or that cannot be resolved at the Element level shall be forwarded to the Program Office for resolution.

3.2 RELATIONSHIPS TO OTHER PROGRAMS AND AGREEMENTS

3.2.1 Internal Relationships and Agreements

Internal relationships and agreements are those that exist within NASA between the various programs and Centers.

Internal agreements that may be concluded with the authority of the HRP Program Manager include those with organizations at the NASA Centers, including other program offices. These agreements shall be formally documented either though the use of Memoranda of Agreement (MOA) or the PPBE process, including the use of ITAs and BCDs.

Internal agreements that must be developed under the authority of the ESMD include agreements with other NASA organizations that require reprogramming of funds.

3.2.2 External Relationships and Agreements

External relationships and agreements are those that exist with organizations outside NASA.

External agreements that may be concluded under the authority of the Program Manager include partnering opportunities as solicited through Internal Calls for Proposals, directed research projects, AOs, and BAAs.

External agreements that must be developed under the authority of the ESMD include agreements with other federal agencies and United States industries for the purpose of sharing research facilities, multi-user hardware, and collaboration on research activities of mutual interest. These also include agreements with international space agencies for the purpose of sharing research facilities, multi-user hardware, and collaboration on research activities of mutual interest.

The current list of external agreements is presented in Appendix F.

3.3 BUDGET AND ACQUISITION STRATEGY

The HRP elements and projects shall use the NASA PPBE process to generate their baseline budgets.

The HRP shall use available NASA and ESMD acquisition methods, such as AOs, BAAs, NRAs, and Internal Calls for Proposals to acquire research and technology development support. Directed in-house research is another acceptable acquisition method. Small Business Innovation Research (SBIR) grants shall also be used when appropriate.

The HRP will use Directed Research as an acquisition method for obtaining selected research data and technology development. Directed research may be used when:

a. A gap analysis identifies the need in an area for which NASA internal organizations possess specific competency. Selected organizations are then directly assigned tasks.

b. A survey of external research identifies results of potential significant benefit to the HRP. The HRP then acquires additional research work through either internal or external sources to provide data of value to the Program. NSBRI will be used for external research acquisition to the maximum extent possible.

Participating NASA Centers also utilize competitive contracts for procurement of support to intramural project tasks. The Centers have multiple options for procurements and shall select the optimal procurement method based on the Agency policy of the widest possible use of competitive processes.

3.4 RESEARCH AND TECHNOLOGY STRATEGY

3.4.1 Basic and Applied Research

The HRP shall perform research tasks that focus on the reduction of the most significant health risks to the crew as a result of exploration missions and increase the knowledge base to inform the development of standards for human support systems. This shall include basic and applied research to inform crew health and medical standards and guide the development of human health countermeasures.

Basic and applied research shall include the test and validation of hypotheses, formulation of countermeasure concepts and initial demonstration of efficacy, clinical trials/testing, and finally, validation and delivery for operational implementation.

The Transition to Medical Practice (TMP) process defined by the OCHMO is used to review and approve HRP deliverable countermeasures and technologies prior to their operational use.

3.4.2 Countermeasures Development

For countermeasures development, HRP shall nominally begin at CRL-4 and develop selected countermeasures to CRL-7 or -8 at which point they shall be transferred to the implementing organization for incorporation. See Figure 3-3.

3.4.3 Technology Development

HRP shall also develop critical human systems technologies to TRL-6 (nominally) by the time of the applicable program element-level PDR. See Figure 3-4. Technology development may include those needed to mature countermeasures as defined in 3.4.2. HRP shall utilize the ISS and ground testbeds to integrate and demonstrate technologies. Technology deliverables shall be transitioned to the customer for final maturation, development, and insertion into the flight program.

Before technologies are delivered, HRP shall complete an infusion process, which includes assessment of technology readiness levels and successful completion of development control gates. This includes an independent technical review with the participation of the implementing program (e.g. Constellation). This will provide early visibility of technology capabilities to the program and stakeholders, enabling the identification of preferred technology insertion paths. An internal review of the technology development status shall be conducted to assess its readiness for delivery to the targeted customers.

3.4.4 Research and Technology Assessment

When a new research or technology development project or effort is proposed to the HRP, the PIO and the SMO shall cooperatively assess applicability with respect to HRP and ESMD goals and objectives. They shall follow a defined process to evaluate the maturity level and value of the proposed effort. Assessment results shall be presented to HRPCB when portfolio adjustment decisions are required.

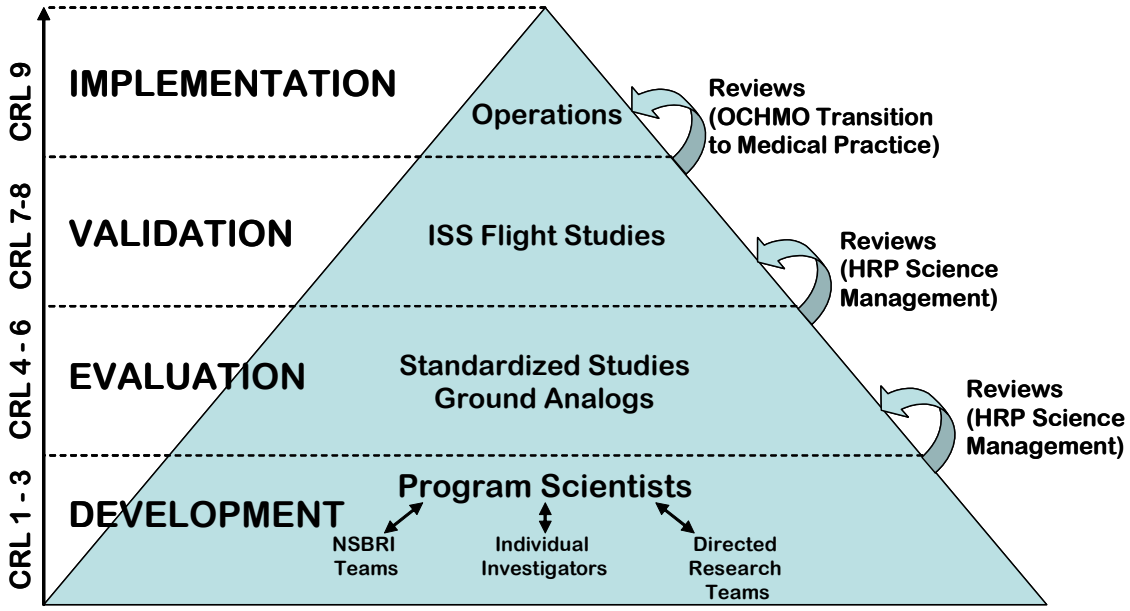


Figure 3-3: Countermeasures Development Process

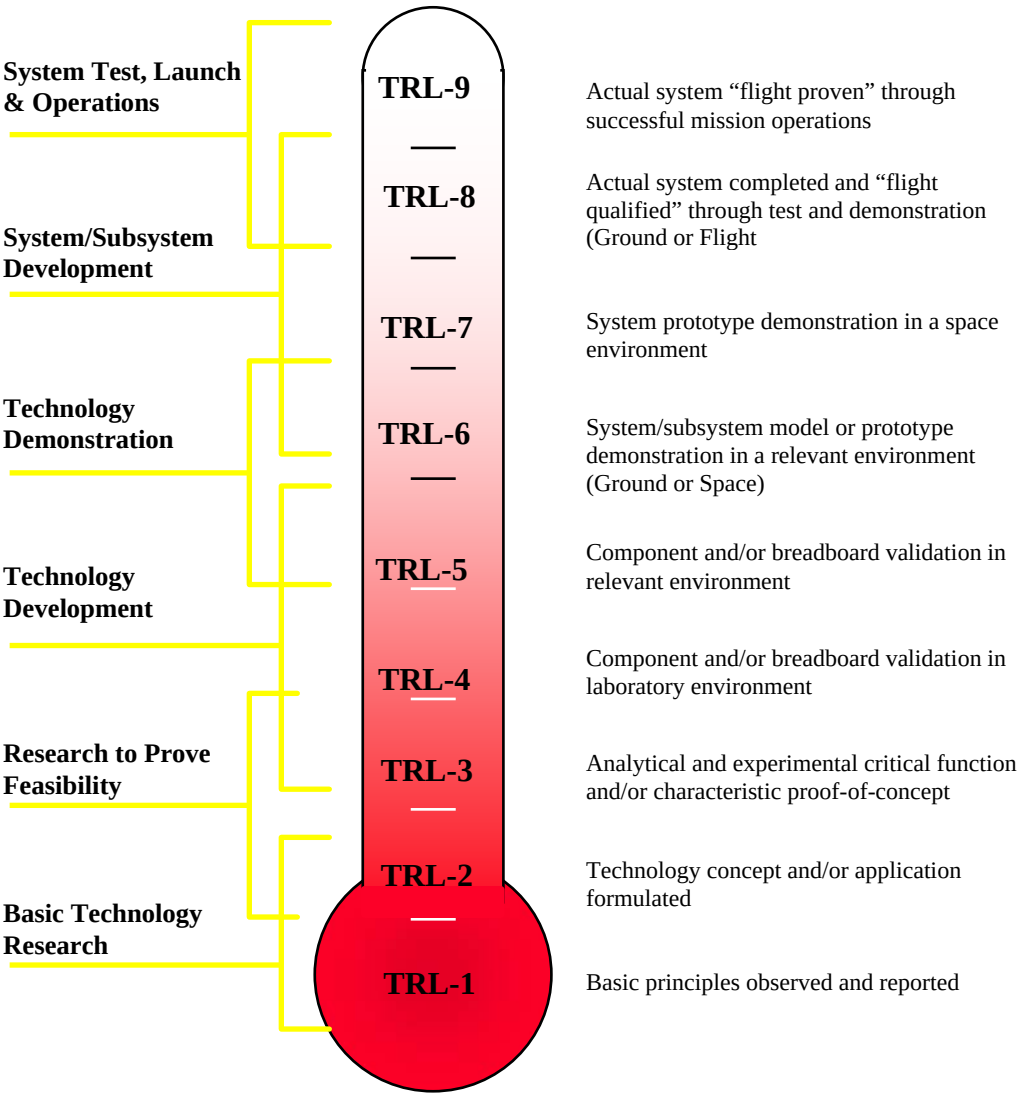


Figure 3-4: Definition of Technology Readiness Levels

3.5 COOPERATION AND COMMERCIALIZATION

The JSC Technology Transfer and Commercialization Office (TTCO) shall support the HRP to identify and evaluate commercial opportunity options. As applicable, the JSC TTCO shall support the HRP to develop specific commercialization partnership and/or tech transfer opportunities. Similarly, the supporting NASA Centers shall use their own commercialization and technology transfer organization, as appropriate, in support of their content.

Partnership development support includes industry market analysis, search for and connection to potential partners, partnership due diligence and valuation, and agreement negotiation and definition.

3.6 DATA MANAGEMENT AND DISTRIBUTION

The program shall undertake an effort to develop an integrated data archive and collection process using standard tools. Archives currently in use and applicable plans and policies to be implemented by the HRP are described below.

The data and documents developed under this Program shall be stored in JSC/SLSD managed databases and shall be available through controlled access in accordance with JSC policy.

The Life Sciences Data Archive (LSDA) provides a system to capture and disseminate life science research findings. It currently contains summarized flight experiments and descriptions of research results with references to publications, as well as raw data files from flight. Data management and distribution capabilities are also available within the LSDA system, and may be used to collect structured data for experiments, distribute that data, and archive experiment data for future use. Astronaut data that are collected for clinical purposes are available for research through the Longitudinal Study of Astronaut Health (LSAH). A written request for research data must be submitted to the LSAH Executive Committee, which shall review and disposition all requests for information in accordance with the Privacy Act of 1974.

The HRP shall comply with the intent of JMI 1382.5, Appendix P. This document has been modified and supplemented by "Policy Guidelines for Space Flight Medical Research Experiments," a policy approved by the Space and Life Sciences and Flight Crew Operations Directorates on March 8, 1995.

At the task and project level, each investigator or project shall submit details of a data sharing plan if applicable. A plan to protect privacy of medical data which includes safeguards for electronically stored data shall be submitted by the investigator or project. No data attributable to an individual shall be publicly released without the written permission of the subject. This concept encompasses non-disclosure of an individual's name, and requires sufficient pooling of data to preclude determining an individual's identity by combining or cross-referencing data (e.g., height, weight, sex, and flight number may identify a specific individual).

HRP documents may also include published journal articles, conference papers, and/or technical presentations generated by extramural and/or intramural researchers. HRP deliverables shall be archived using approved database applications.

The HRP shall utilize an ESMD-provided storage location and tools for documents and project schedules. The HRP shall assess the utility of the provided integral capabilities for collaborative development and control of HRP Program and Project information and processes and utilize capabilities where effective. A goal within the HRP is to maximize the availability and access of data by appropriate users within fiscal constraints.

3.7 SAFETY AND MISSION ASSURANCE (S&MA)

3.7.1 Research S&MA

3.7.1.1 Human Test Subjects

For NASA-funded investigations involving human subjects, the Project shall comply with NPR 7100.1 and NPD 7100.8 to insure the health, safety, and privacy of the subjects are protected. For international projects, project strategies shall be submitted for additional review by the Human Research Multilateral Review Board.

3.7.1.2 Animal Test Subjects

For projects involving animal subjects, the Project shall obtain prior approval from the Institutional Animal Care and Use Committee (IACUC) for the appropriate testing location and shall also comply with the *NRC Guide for the Care and Use of Laboratory Animals* and the *Animal Welfare Act* (Code Fed. Reg. Title 9), NPD 8910.1, and NPR 8910.1.

3.7.1.3 Ground Research

Ground-based research will be conducted at multiple NASA Field Centers and non-NASA facilities. The HRP Projects shall comply with the approved safety and quality standards for the performing Center and Facility.

3.7.1.4 Flight Research

For flight research, the Project shall comply with the applicable standards and procedures governing flight payloads including NSTS 1700.7 and SSP 50021. The ISSMP Project Manager and the funding Project Manager shall ensure that S&MA processes are properly established and implemented within the project.

3.7.2 Technology Development

Technology development projects shall comply with S&MA requirements at the relevant centers.

3.8 RISK MANAGEMENT STRATEGY

The HRP Program Manager shall implement a continuous risk management process in accordance with NPR 8000.4. During the early stages of the Program, risk management shall be performed as defined in Appendix E.

Initially, the HRP shall use the HRP Integrated Risk Management Application (HRP IRMA) as the common database for documenting and tracking program risks. From the HRP IRMA, risks shall be transported to other program databases, as appropriate; the ESMD Active Risk Manager (ARM), the JSC Center IRMA for Center-related risks, the ISS Program IRMA for all ISS-unique risks, and the Space Shuttle Program IRMA for all Shuttle-specific risks. The HRP shall use ARM to track only top Program risks and those risks that affect other ESMD programs.

The HRP shall develop a plan to transition from IRMA to ARM as the Program risk management tool and to fully implement the ESMD risk management process in accordance with EXPLORATION-RMP-0001.

3.9 ENVIRONMENTAL IMPACT

The HRP requires each project to evaluate the environmental risks and liabilities associated with the project. If required, the Project shall develop an Environmental Management Plan per the process described in NPR 7120.5, paragraph 3.2.1.2k. The Project Manager is responsible for compliance with environmental requirements. When necessary, documentation is developed associated with environmental compliance considerations, including an Environmental Assessment or an Environmental Impact Statement.

The HRP Program Manager shall comply with the following responsibilities, defined in NPD 8500.1:

- Implement environmental policies and requirements within existing programs and projects, including life cycle planning, development, execution, and disposition activities
- Ensure that requirements of the National Environmental Policy Act (NEPA) are satisfied for any proposed new or modified programs and projects
- Coordinate with the local environmental managers on both existing and new programs and projects to ensure compliance with law and the effective implementation of environmental requirements.

3.10 INSTITUTIONAL AND LOGISTICS

Institutional facilities and equipment currently exist at various NASA Centers to support HRP projects, including ARC, GRC, JSC, KSC, and MSFC. Detailed descriptions of facilities and equipment to support specific projects shall be included in the HRP Project Plans.

External to NASA, the NSBRI consortium consisting of twelve member institutions provides facilities and equipment to support research and technology development aimed at preventing or addressing health problems related to long-duration space travel and prolonged exposure to microgravity.

In addition, the HRP Program utilizes bed rest facilities at the University of Texas Medical Branch in Galveston, Texas, and has access to similar facilities in Europe through partnering agreements with international agencies. The Program will also utilize parabolic aircraft as needed to support its research projects.

The HRP makes use of the NASA Space Radiation Laboratory (NSRL) at the U.S. Department of Energy (DoE) Brookhaven National Laboratory, as well as other DoE laboratories and international laboratories. The HRP also utilizes radiation test facilities at the Loma Linda University Medical Center.

The ISS and Shuttle serve as test beds for research and validation of countermeasures and systems as described in the HRP Project Plans.

The HRP shares mission-specific usage costs of certain non-NASA facilities including the Aquarius Habitat operated by the University of North Carolina.

The General Clinical Research Center and the Lerner Research Institute at the Cleveland Clinic provide facilities supporting HRP. These facilities provide bedrest and six degree head down tilt simulation along with a Zero-gravity Locomotion Simulator (ZLS). The ZLS is a horizontal treadmill providing footfall forces and conditioning similar to that of the treadmill used on ISS.

3.11 PHYSICAL AND INFORMATION TECHNOLOGY SECURITY

To ensure export controlled data, human subject privacy data, and NASA internal data are protected appropriately, HRP shall manage its information in accordance with NASA information technology security policy, including export control per NPR 2190.1 and information security per NPR 2810.1.

3.12 VERIFICATION AND VALIDATION

The verification and validation for HRP deliverables are project unique and shall be documented in the Project Plans. The verification and validation will also be driven by the Constellation Program requirements.

The Elements and Projects shall subject hardware and software used in flight experiments and tests to functional verification and safety reviews as required by the Shuttle and ISS programs. The Elements and Projects shall document these activities in Project Verification and Validation Plans as required by the appropriate Shuttle and ISS requirements.

3.13 REVIEWS AND REPORTING

3.13.1 Program Reviews and Reporting

The HRP shall conduct management and technical reviews to maintain cognizance of current status and risks, and to discuss progress toward accomplishment of goals and objectives for the Program. The HRP shall provide monthly, quarterly, and annual reports and status briefings to ESMD as listed in Table 3-1 to keep the Directorate apprised of current project status, costs, schedules, and risks.

The HRP represents the human health, performance, and human systems integration content from the previous Human Systems Research and Technology (HSRT) Theme. As such, HRP can be considered an existing program under the terms of NPR 7120.5.

The content of the HSRT was reviewed and modified by ESMD during the Zero-Base Review (ZBR) process in FY ’04-’05. The content of the HRP was further modified in FY ’05-‘06 to reflect the Exploration Systems Architecture Study (ESAS) results and report, by the Independent Program Assessment Office (IPAO), and as a result of budget constraints imposed as part of the PPBE process. This series of evaluations constitutes the Non-Advocate Review (NAR) for this Program.

Program Implementation Reviews (PIR) shall be conducted in accordance with NPR 7120.5 every two years starting from the approval date of this Program Plan.

The primary method for reporting project status shall be through monthly reports and quarterly presentations from the Elements and Projects to the Program Management team. The Program Manager shall determine the level and formality of reporting required. As a minimum, the reports shall include schedule tracking, risk summary, progress reporting, and cost.

3.13.2 Research Reviews

The quality of basic and applied research efforts within HRP is assured by competition and peer review, where peer review means independent evaluation by internal or external subject matter experts who do not have a conflict of interest. The following peer review methods will be used by HRP.

For all new investigations (science and technology) selected through the NRA process, Peer Reviews shall be conducted in accordance with NPR 1080.1 and the HRP Science Management Plan to determine the quality, relevance, and value of the work being proposed.

For all new and existing investigations not selected through the NRA process, NARs shall be conducted as defined in the HRP Science Management Plan to assess the quality, relevance, and value of the research and technology development work being performed with respect to the changing requirements and needs of the ESMD.

The HRP Elements and Projects shall support Certification of Flight Readiness Reviews (CoFR) per JSC 28225 and Safety and Mission Success Review (SMSR) as necessary for missions involving HRP research objectives or flight experiments.

The requirements for reviews and reports for the HRP research and technology development activities are listed in Table 3-1.

3.13.3 Other Reviews

The HRP Program Manager shall recommend use of advisory boards when external advice is required. Any advisory board usage shall be approved and managed by ESMD. Examples of advisory boards relevant to HRP include the National Research Council (NRC), National Academy of Sciences (NAS), the National Academy of Engineering (NAE), and the Institute of Medicine (IOM). Elements and projects shall use focused advisory boards or working groups when external advice specific to element or project objectives are required.

The Elements and Projects shall utilize independent reviews for safety and bioethical considerations for research involving human or animal subjects per NPD 7100.8 and NPD 8910.1.

The HRP shall support independent assessments, external audits, and other program evaluations as required by NPR 7120.5.

Table 3-1: HRP Program Reporting and Reviews

Review / Report	Frequency	Customer Organization	Input Responsibility
ESMD Level			
HRP Monthly Activity Report (MAR)	Monthly	ESMD	HRP Program Office
HRP Quarterly Review	Quarterly	ESMD	HRP Program Office
Planning, Programming, Budgeting, and Execution (PPBE)	Annual	ESMD / HRP	Elements and Projects
Program Implementation Review (PIR)	Every two years after Plan approval	ESMD / ESMD designated independent review team	HRP Program Office
Cancellation Reviews	As required	ESMD / HRP	Elements and Projects
Program Level			
Monthly Activity Report (MAR)	Monthly	HRP Program Office	Elements and Projects
HRP Quarterly Review (TCSR)	Quarterly	HRP Program Office	Elements and Projects
Certification of Flight Readiness (CoFR) Review	Prior to related launch	Flight Vehicle Program Office	JSC/SLSD (SA3) and Elements and Projects
Research Reviews			
Peer Review	Once per investigation	HRP Program Office	Elements, Projects, and Principal Investigators
Research Non-Advocate Review (NAR)	As required	HRP Program Office	Elements, Projects, and Principal Investigators
Safety and Mission Assurance Readiness Review (SMSR)	Prior to related launch	S&MA	Elements and Projects

3.14 EDUCATION AND PUBLIC OUTREACH

The HRP Education and Outreach (E&O) provides educational and general information to students, educators, and the general community to help clearly communicate the full scope of NASA HRP research. The target audience ranges from K-12 and higher education to professional and life-long learning. The focus of this material is to communicate relevant aspects of the Human Research Program and to help stimulate students to further their education in math, science, engineering and related technology fields.

3.15 TERMINATION REVIEW CRITERIA

The HRP shall review the status of each Program Element at least annually and assess the ability of the element or project to meet its objectives. HRP Projects are subject to termination as authorized by the HRP Program Manager in consultation with ESMD. Criteria for project or task termination may include:

- Strategic: inconsistent with the Exploration vision; inconsistent with the program/mission objectives; overlap with another funded activity; or low priority ranking for HRP or Program Element given funding constraints
- Technical/Scientific: performance measures indicate that the technology will not achieve the required technical results by the scheduled need date; performance measures indicate degradation in projected performance versus performance commitments; product delivered is of insufficient quality and/or does not meet performance requirements
- Cost: over budget by 5% per year for a Program Element; over budget by 15% per year for a project
- Schedule: missed milestone(s) or key decision points; missed due dates for major activities, projected delay in the operational readiness review greater than 6 months from the committed date
- Noncompliance with Agency or ESMD policy
- Knowledge sought is obtained through means other than the current HRP-funded activities.

3.16 DEVIATIONS AND WAIVERS

There are no known deviations or waivers against NASA policies, directives or external requirements, either in existence within HRP or to be obtained by HRP.

3.17 CHANGE LOG

This plan is baselined and controlled through the HRPCB.

DOCUMENT CHANGE / REVISION LOG

CHANGE/ REVISION	DATE	DESCRIPTION OF CHANGE	PAGES AFFECTED
Baseline	6/1/06	Original Release	

APPENDIX A: APPLICABLE DOCUMENTS

The following documents of the specified revision, or the latest revision if not identified, form a part of this Plan to the extent defined herein.

Document No.	Revision	Document Title
	March 8, 1995	Policy Guidelines for Space Flight Medical Research Experiments (SLSD / FCOD)
Code Fed. Reg. Title 9		Animal Welfare Act
		NRC Guide for the Care and Use of Laboratory Animals
EXPLORATION-RMP-0001	Version 1.0 April 11, 2006	Exploration Systems Risk Management Plan
JMI 1382.5 Appendix P		Maintaining Privacy of Biomedical Research Data
JSC 28225	Revision D	Space and Life Sciences Directorate Certification of Flight Readiness (CoFR) Implementation Plan
JSC 28330	Revision C	Space and Life Sciences Directorate Configuration Control Management Plan
NASA / SP-2004-6113	Feb. 2005	Bioastronautics Roadmap
NASA-STD-3000	Revision C	Man-Systems Integration Standards
NPD 1000.0	August 2005	NASA Strategic Management and Governance Handbook
NPD 7100.8	Revision D	Protection of Human Research Subjects
NPD 8500.1	Revision A	NASA Environmental Management
NPD 8910.1	Revision A	Care and Use of Animals
NPR 2810.1	August 26, 1999	Security of Information Technology
NPR 1080.1	February 2, 2005	NASA Science Management
NPR 2190.1	April 10, 2003	NASA Export Control Program
NPR 5800.1	May 19, 2005	NASA Grant and Cooperative Agreement Handbook
NPR 7100.1	March 28, 2003	Protection of Human Research Subjects

Document No.	Revision	Document Title
NPR 7120.5	Revision C	NASA Program and Project Management Processes and Requirements
NPR 8000.4	April 25, 2002	Risk Management Procedural Requirements
NPR 8910.1	Revision A	Care and Use of Animals
NSTS 1700.7	Revision B	Safety Policy and Requirements for Payloads Using the Space Transportation System
SSP 50021	Sept. 4, 1996	Safety Requirements Document

APPENDIX B: ACRONYMS AND ABBREVIATIONS

AA	Associate Administrator
ACD	Advanced Capabilities Division
AO	Announcement of Opportunity
APA	Allowance for Programmatic Adjustment
ARC	Ames Research Center
ARM	Active Risk Manager
BAA	Broad Agency Announcement
BCD	Budget Change Directive
BHP	Behavioral Health and Performance
CCB	Change Control Board
CoFR	Certification of Flight Readiness
CRL	Countermeasure Readiness Level
DoE	Department of Energy
DPMC	Directorate Program Management Council
E&O	Education and Outreach
ESAS	Exploration Systems Architecture Study
ESMD	Exploration Systems Mission Directorate (HQ)
EVA	Extravehicular Activity
ExMC	Exploration Medical Capability
FY	Fiscal Year
GPRA	Government Performance and Results Act
GRC	Glenn Research Center
HACD	Human Adaptation and Countermeasures Division (SLSD)
HEFD	Habitability and Environmental Factors Division (SLSD)
HHC	Human Health Countermeasures
HQ	Headquarters (NASA)
HRP	Human Research Program
HRPCB	Human Research Program Control Board
HRP SMO	Science Management Office (HRP)
HSIS	Human Systems Integration Standards

HSRT	Human Systems Research and Technology
IACUC	Institutional Animal Care and Use Committee
IOM	Institute of Medicine
IPAO	Independent Program Assessment Office
IRMA	Integrated Risk Management Application
ISS	International Space Station
ISSMP	ISS Medical Project
ITA	Internal Task Agreement
JSC	Johnson Space Center
KSC	Kennedy Space Center
LaRC	Langley Research Center
LSAH	Longitudinal Study of Astronaut Health
LSDA	Life Sciences Data Archive
MAR	Monthly Activity Report
MOA	Memorandum (Memoranda) of Agreement
MSFC	Marshall Space Flight Center
NAE	National Academy of Engineering
NAR	Non-Advocate Review
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NIH	National Institute of Health
NRA	NASA Research Announcement
NRC	National Research Council
NSBRI	National Space Biomedical Research Institute
NSRL	National Space Radiation Laboratory
OBPR	Office of Biological and Physical Research
OCHMO	Office of the Chief Health and Medical Officer
PART	Program Assessment and Rating Tool
PCA	Program Commitment Agreement
PDR	Preliminary Design Review
PIO	Program Integration Office

PIR	Program Implementation Review
PMC	Program Management Council
PPBE	Planning, Programming, Budgeting, and Execution
S&MA	Safety and Mission Assurance
SBIR	Small Business Innovation Research
SLSD	Space Life Sciences Directorate (JSC)
SM	Space Medicine Division (SLSD)
SMO	Science Management Office
SMP	Science Management Panel (HRP SMO)
SMP	Science Management Plan
SMSR	Safety and Mission Success Review
SOMD	Space Operations Mission Directorate (HQ)
SRR	System Requirements Review
TCSR	Technical, Cost, and Schedule Review
TRL	Technology Readiness Level
TTCO	Technology Transfer and Commercialization Office
WBS	Work Breakdown Structure
ZBR	Zero-Base Review
ZLS	Zero-gravity Locomotion Simulator

APPENDIX C: PROGRAM WORK BREAKDOWN STRUCTURE

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
428A	**046193**						**HumanHealth&PerformanceProg/Science Mgt**
		046193.01					**Portfolio Management**
			046193.01.01				**ARC-Portfolio Management**
				046193.01.01.01			ARC-Program / Science Management
				046193.01.01.02			ARC-ISSRC Flight Project Management
				046193.01.01.03			ARC-Termination/De-Scoping Liability
			046193.01.02				**GRC-Portfolio Management**
				046193.01.02.01			GRC-Program / Science Management
				046193.01.02.02			GRC-ISSRC Flight Project Management
				046193.01.02.03			GRC-Termination/De-Scoping Liability
				046193.01.05.03			KSC-Termination/De-Scoping Liability
			046193.01.06				**MSFC-Portfolio Management**
				046193.01.06.01			MSFC-Program / Science Management
				046193.01.06.02			MSFC-ISSRC Flight Project Management
				046193.01.06.03			MSFC-Termination/De-Scoping Liability
		046193.02					**Funded Research/Awards**
			046193.02.01				**ARC-Funded Research/Awards**
				046193.02.01.01			ARC-Labor and Travel
				046193.02.01.02			ARC-Core Competency Management
			046193.02.02				**GRC-Funded Research/Awards**
				046193.02.02.01			GRC-Labor and Travel
				046193.02.02.02			GRC-Core Competency Management

This appendix presents the approved WBS for FY ’06. It will be revised for FY ’07 at a later date.

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
			046193.02.03				**HQ-Funded Research/Awards**
				046193.02.03.01			HQ-Labor and Travel
				046193.02.03.02			HQ-Core Competency Mgmt/De-Scoping
			046193.02.04				**JSC-Funded Research/Awards**
				046193.02.04.01			JSC-Labor and Travel
				046193.02.04.02			JSC-Core Competency Management
			046193.02.05				**KSC-Funded Research/Awards**
				046193.02.05.01			KSC-Labor and Travel
				046193.02.05.02			KSC-Core Competency Mgmt/De-Scoping
			046193.02.06				**MSFC-Funded Research/Awards**
				046193.02.06.01			MSFC-Labor and Travel
				046193.02.06.02			MSFC-Core Competency Management
		046193.03					**Facilities, Testbeds & Operations**
			046193.03.01				**ARC-Facilities, Testbeds & Operations**
			046193.03.02				**GRC-Facilities, Testbeds & Operations**
			046193.03.03				**HQ-Facilities, Testbeds & Operations**
			046193.03.04				**JSC-Facilities, Testbeds & Operations**
				046193.03.04.01			JSC-Flt Projects Mgmt (formerly ISSRC)
					046193.03.04.01.02		JSC-Sustaining Engineering
					046193.03.04.01.03		JSC-Experiment Unique Equip (EUE)
					046193.03.04.01.04		JSC-Utilization
					046193.03.04.01.06		JSC-Telescience Support Center
				046193.03.04.02			JSC-Probabilistic Risk Assessment
				046193.03.04.03			JSC-Cooperative Agreement NSBRI
					046193.03.04.03.01		JSC-NSBRI Core
				046193.03.04.05			JSC-Human Research Admin Support
				046193.03.04.06			JSC-Cooperative Agreement USRA
			046193.03.05				**KSC-Facilities, Testbeds & Operations**
			046193.03.06				**MSFC-Facilities, Testbeds & Operations**
428A	**444543**						**Autonomous Medical Care**
		444543.01					**Portfolio Management**
			444543.01.01				**ARC-Portfolio Management**
				444543.01.01.01			ARC-Exploration Medical Capabilities
				444543.01.01.02			ARC-Core Competency Management

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
			444543.01.02				**GRC-Portfolio Management**
				444543.01.02.01			GRC-Exploration Medical Capabilities
				444543.01.02.02			GRC-Termination/De-Scoping Liability
			444543.01.03				**HQ-Portfolio Management**
			444543.01.04				**JSC-Portfolio Management**
				444543.01.04.01			JSC-Exploration Medical Capabilities
				444543.01.04.02			JSC-Termination/De-Scoping Liability
				444543.01.04.07			JSC-ODIN & JIMMS Support
			444543.01.05				**KSC-Portfolio Management**
				444543.01.05.01			KSC-Exploration Medical Capabilities
				444543.01.05.02			KSC-Termination/De-Scoping Liability
			444543.01.06				**MSFC-Portfolio Management**
				444543.01.06.01			MSFC-Exploration Medical Capabilities
				444543.01.06.02			MSFC-Termination/De-Scoping Liability
		444543.02					**Funded Research/Awards**
			444543.02.01				**ARC-Funded Research/Awards**
				444543.02.01.01			ARC-Labor and Travel
				444543.02.01.02			ARC-Core Competency Management
			444543.02.02				**GRC-Funded Research/Awards**
				444543.02.02.01			GRC-Labor and Travel
				444543.02.02.02			GRC-Core Competency Management
			444543.02.03				**HQ-Funded Research/Awards**
				444543.02.03.01			HQ-Labor and Travel
				444543.02.03.02			HQ-Core Competency Mgmt/De-Scoping
			444543.02.04				**JSC-Funded Research/Awards**
				444543.02.04.01			JSC-Labor and Travel
				444543.02.04.02			JSC-Core Competency Management
				444543.02.04.03			JSC-NSBRI Medicine
				444543.02.04.04			JSC-NSBRI Integrated Data Management
				444543.02.04.05			JSC-EMC HW Test & Analysis
				444543.02.04.07			JSC-NSBRI Mechanisms of Injury
			444543.02.05				**KSC-Funded Research/Awards**
				444543.02.05.01			KSC-Labor and Travel
				444543.02.05.02			KSC-Core Competency Mgmt/De-Scoping

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
			444543.02.06				**MSFC-Funded Research/Awards**
				444543.02.06.01			MSFC-Labor and Travel
				444543.02.06.02			MSFC-Core Competency Mgmt/De-Scoping
		444543.03					**Facilities, Testbeds & Operations**
			444543.03.01				**ARC-Facilities, Testbeds & Operations**
			444543.03.02				**GRC-Facilities, Testbeds & Operations**
			444543.03.03				**HQ-Facilities, Testbeds & Operations**
			444543.03.04				**JSC-Facilities, Testbeds & Operations**
				444543.03.04.01			JSC-Emc Core
			444543.03.05				**KSC-Facilities, Testbeds & Operations**
			444543.03.06				**MSFC-Facilities, Testbeds & Operations**
237A	**466199**						**Space Human Factors Engineering (SHFE)**
		466199.01					**Portfolio Management**
			466199.01.01				**ARC-Portfolio Mangement**
				466199.01.01.01			ARC-Space Human Factors Engineering
				466199.01.01.02			ARC-Termination/De-Scoping Liability
			466199.01.02				**GRC-Portfolio Management**
				466199.01.02.01			GRC-Space Human Factors Engineering
				466199.01.02.02			GRC-Termination/De-Scoping Liability
			466199.01.03				**HQ-Portfolio Management**
			466199.01.04				**JSC-Portfolio Management**
				466199.01.04.01			JSC-Space Human Factors Engineering
					466199.01.04.01.03		JSC-Workshops
				466199.01.04.02			JSC-Termination/De-Scoping Liability
				466199.01.04.07			JSC-ODIN & JIMMS Support
			466199.01.05				**KSC-Portfolio Management**
			466199.01.06				**MSFC-Portfolio Management**
		466199.02					**Funded Research/Awards**
			466199.02.01				**ARC-Funded Research/Awards**
				466199.02.01.01			ARC-Labor and Travel
				466199.02.01.02			ARC-Core Competency Management
			466199.02.02				**GRC-Funded Research/Awards**

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
			466199.02.03				**HQ-Funded Research/Awards**
				466199.02.03.01			HQ-Labor and Travel
				466199.02.03.02			HQ-Core Competency Mgmgt/De-Scoping
			466199.02.04				**JSC-Funded Research/Awards**
				466199.02.04.01			JSC-Labor and Travel
				466199.02.04.02			JSC-Core Competency Management
				466199.02.04.03			JSC-Space Human Factors
					466199.02.04.03.01		JSC-Active Grants
						466199.02.04.03.01.04	JSC-UTAF R&TD Speech Recognition
						466199.02.04.03.01.05	JSC-UTAF R&TD Badler Support
						466199.02.04.03.01.12	JSC-Automatic Speech Recognition
						466199.02.04.03.01.13	JSC-RMS Operator Proficiency
						466199.02.04.03.01.14	JSC-DoD Tag
					466199.02.04.03.03		JSC-Human Factors Projects
						466199.02.04.03.03.02	JSC-ABF R&TD
						466199.02.04.03.03.03	JSC-UTAF R&TD Support
						466199.02.04.03.03.06	JSC-Lessons Learned TDP
						466199.02.04.03.03.07	JSC-Gap Analysis
						466199.02.04.03.03.08	JSC-GRAF / LETF R&TD
						466199.02.04.03.03.09	JSC-HDC R&TD
						466199.02.04.03.03.10	JSC-HSIS, Vol. 1
						466199.02.04.03.03.11	JSC-CEL
				466199.02.04.04			JSC-Advanced Food
					466199.02.04.04.03		JSC-Advanced Food Technology
						466199.02.04.04.03.01	JSC-Advanced Food Technology
						466199.02.04.04.03.02	JSC-DoD Collaboration
				466199.02.04.05			JSC-Environmental Standards
					466199.02.04.05.03		JSC-Environmental Standards
						466199.02.04.05.03.01	JSC-Lunar Dust Studies
						466199.02.04.05.03.03	JSC-AEMC Support
			466199.02.05				**KSC-Funded Research/Awards**
				466199.02.05.01			KSC-Labor and Travel
				466199.02.05.02			KSC-Core Competency Mgmt/De-Scoping

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
			466199.02.06				**MSFC-Funded Research/Awards**
				466199.02.06.01			MSFC-Labor and Travel
				466199.02.06.02			MSFC-Core Competency Mgmt/De-Scoping
		466199.03					**Facilities, Testbeds & Operations**
			466199.03.01				**ARC-Facilities, Testbeds & Operations**
			466199.03.02				**GRC-Facilities, Testbeds & Operations**
			466199.03.03				**HQ-Facilities, Testbeds & Operations**
			466199.03.04				**JSC-Facilities, Testbeds & Operations**
				466199.03.04.01			JSC-Project Management
					466199.03.04.01.03		JSC-Project Management
			466199.03.05				**KSC-Facilities, Testbeds & Operations**
			466199.03.06				**MSFC-Facilities, Testbeds & Operations**
428A	**516724**						**Human Health Countermeasures**
		516724.01					**Portfolio Management**
			516724.01.01				**ARC-Portfolio Management**
				516724.01.01.01			ARC-Human Health Countermeasures
				516724.01.01.02			ARC-Termination/De-Scoping Liability
			516724.01.02				**GRC-Portfolio Management**
				516724.01.02.01			GRC-Human Health Countermeasures
				516724.01.02.02			GRC-Termination/De-Scoping Liability
			516724.01.03				**HQ-Portfolio Management**
			516724.01.04				**JSC-Portfolio Management**
				516724.01.04.01			JSC-Human Health Countermeasures
				516724.01.04.02			JSC-Termination/De-Scoping Liability
				516724.01.04.07			JSC-ODIN & JIMMS Support
			516724.01.05				**KSC-Portfolio Management**
				516724.01.05.01			KSC-Human Health Countermeasures
				516724.01.05.02			KSC-Termination/De-Scoping Liability
			516724.01.06				**MSFC-Portfolio Management**
				516724.01.06.01			MSFC-Human Health Countermeasures
				516724.01.06.02			MSFC-Termination/De-Scoping Liability

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
		516724.02					**Funded Research/Awards**
			516724.02.01				**ARC-Funded Research/Awards**
				516724.02.01.01			ARC-Labor and Travel
				516724.02.01.02			ARC-Core Competency Management
			516724.02.02				**GRC-Funded Research/Awards**
			516724.02.03				**HQ-Funded Research/Awards**
				516724.02.03.01			HQ-Labor and Travel
				516724.02.03.02			HQ-Core Competency Mgmt/De-Scoping
			516724.02.04				**JSC-Funded Research/Awards**
				516724.02.04.01			JSC-Labor and Travel
				516724.02.04.02			JSC-Core Competency Management
				516724.02.04.03			JSC-Exercise Countermeasures Project
					516724.02.04.03.01		JSC-ECP Integration & Operations
					516724.02.04.03.02		JSC-Ground Based 0-g Research & Tech
						516724.02.04.03.02.01	JSC-A Qauntitative Test of On-Orbit Ex.
							JSC-CEVP Close-Out
						516724.02.04.03.02.02	JSC-Influence of Exercise on Human S.
						516724.02.04.03.02.03	JSC-Ground Based 0-gravity Research and
					516724.02.04.03.03		JSC-Ground Based 1/6-g Research & Tech
					516724.02.04.03.04		JSC-NSBRI Core
						516724.02.04.03.04.01	JSC-NSBRI Core Sensorimotor Adaptation
						516724.02.04.03.04.02	JSC-NSBRI Core Tactile Sensory Supplement
						516724.02.04.03.04.03	JSC-NSBRI Core Effects of Mscle Countr
						516724.02.04.03.04.04	JSC-NSBRI Core Effects of SpaceFlight CS
						516724.02.04.03.04.05	JSC-NSBRI Core Pharmaco Intranasal Scopa
					516724.02.04.03.05		JSC-ECP ISS Flight Research and Technology
						516724.02.04.03.05.01	JSC-Effect of Long Duration Spaceflt
				516724.02.04.04			JSC-Fractional Gravity Project (FGP)
					516724.02.04.04.01		JSC-Fractional Gravity Project (FGP)
				516724.02.04.05			JSC-Non-Exercise Countermeasures Project
					516724.02.04.05.01		JSC-NxPCM Project Management and Controls
						516724.02.04.05.01.01	JSC-Project Integration Staff
						516724.02.04.05.01.02	JSC-Project Management and Controls
					516724.02.04.05.02		JSC-NxPCM Special Projects
						516724.02.04.05.02.01	JSC-NxPCM PNUT Stability Study

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
							JSC-PNUT Stability Study Project
						516724.02.04.05.02.02	JSC-NxPCM CEVP Transition
						516724.02.04.05.02.03	JSC-CEVP Close-out
					516724.02.04.05.03		JSC-NxPCM Flight Research
						516724.02.04.05.03.01	JSC-NxPCM Bone
							JSC-MRI
							JSC-Renal Stone Risk Cntrmeasure Val
							JSC-Sub-Regional Asses Bone Loss
						516724.02.04.05.03.02	JSC-NxPCM Muscle
							JSC-Efct Spcflt Human Skeletal Muscle
							JSC-Foot React Forces
						516724.02.04.05.03.04	JSC-NxPCM Immunology Infection & Hematol
							JSC-Flt Induced Change Imm. Def
							JSC-Icid. Latent Virus Shedding
							JSC-Microorgans & Allergens
							JSC-Reactivation Latent Epstn-Barr Virus
							JSC-Effcts of Sim Spaceflght (Brks AFB)
						516724.02.04.05.03.05	JSC-NxPCM Pharmacology
							JSC-Gastro Function Ext. Spcflt
							JSC-Effcts of PMZ
						516724.02.04.05.03.07	JSC-NxPCM Sensoy Motor
							JSC-Locomotor Dysfunction
							JSC-Spatial Reorientation
					516724.02.04.05.04		JSC-NxPCM Ground Research
						516724.02.04.05.04.02	JSC-NxPCM Muscle
							JSC-Reten of Skeleton
						516724.02.04.05.04.03	JSC-NxPCM Cardiovascular
							JSC-Vestib-Cerebro
							JSC-Autonomic & Neuro
						516724.02.04.05.04.05	JSC-NxPCM Pharmacology
							JSC-Effects of Sim Micro
							JSC-Ass. Pharm Stability
						516724.02.04.05.04.06	JSC-NxPCM Nutrition
							JSC-Eff of Nut Ex Cm
							JSC-Nut BR Study

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
						516724.02.04.05.04.07	JSC-NxPCM Sensory Motor
							JSC-VR Cybersick Effect
				516724.02.04.06			JSC-EVA Physiological System Project (EP
					516724.02.04.06.01		JSC-EPSP Project Management
					516724.02.04.06.02		JSC-EPSP Pre-Breathe Protocols & Physiol
						516724.02.04.06.02.01	JSC-Mech. Musc. Decomp.
						516724.02.04.06.02.02	JSC-Bubble Dynamic Models
						516724.02.04.06.02.03	JSC-AirBrk 100% O2
						516724.02.04.06.02.04	JSC-EPSP Pre-Breathe Protocols & Physiol
					516724.02.04.06.03		JSC-EPSP Biomedical performance Rqmts &
					516724.02.04.06.04		JSC-EPSP Adjunct Studies & Characterizat
			516724.02.05				**KSC-Funded Research/Awards**
				516724.02.05.01			KSC-Labor and Travel
				516724.02.05.02			KSC-Core Competency Mgmt/De-Scoping
			516724.02.06				**MSFC-Funded Research/Awards**
				516724.02.06.01			MSFC-Labor and Travel
				516724.02.06.02			MSFC-Core Competency Mgmt/De-Scoping
		516724.03					**Facilities, Testbeds & Operations**
			516724.03.01				**ARC-Facilities, Testbeds & Operations**
			516724.03.02				**GRC-Facilities, Testbeds & Operations**
			516724.03.03				**HQ-Facilities, Testbeds & Operations**
			516724.03.04				**JSC-Facilities, Testbeds & Operations**
				516724.03.04.01			JSC-Flight Analog Project
					516724.03.04.01.02		JSC-Flight Analog Project
					516724.03.04.01.03		JSC-FAP MEDES International LTBR Study
				516724.03.04.02			JSC-HTSF
				516724.03.04.03			JSC-Core Labs
					516724.03.04.03.01		JSC-SK BOR
					516724.03.04.03.02		JSC-Sustaining Core Capabilities
			516724.03.05				**KSC-Facilities, Testbeds & Operations**
			516724.03.06				**MSFC-Facilities, Testbeds & Operations**

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
428A	**651549**						**Space Radiation**
		651549.01					**Portfolio Management**
			651549.01.01				**ARC-Portfolio Management**
				651549.01.01.01			ARC-Space Radiation
				651549.01.01.02			ARC-Core Competency Management
			651549.01.02				**GRC-Portfolio Management**
				651549.01.02.01			GRC-Space Radiation
				651549.01.02.02			GRC-Core Competency Management
			651549.01.03				**HQ-Portfolio Management**
			651549.01.04				**JSC-Portfolio Management**
				651549.01.04.01			JSC-Space Radiation
				651549.01.04.02			JSC-Core Competency Management
				651549.01.04.03			JSC-Project Intigration and Support
					651549.01.04.03.01		JSC-Contingency and Program Support
					651549.01.04.03.02		JSC-Project Management IPA Sulzman
					651549.01.04.03.03		JSC-Reserve
				651549.01.04.04			JSC-Workshop and Website Coordination
				651549.01.04.05			JSC-NASA Space Radiobiology Training
				651549.01.04.06			JSC-New Awards
				651549.01.04.07			JSC-ODIN & JIMMS Support
			651549.01.05				**KSC-Portfolio Management**
				651549.01.05.01			KSC-Space Radiation
				651549.01.05.02			KSC Core Competency Management
			651549.01.06				**MSFC-Portfolio Management**
				651549.01.06.01			MSFC-Space Radiation
				651549.01.06.02			MSFC-Core Competency Management
			651549.01.07				**LaRC-Portfolio Management**
				651549.01.07.03			LaRC-Portfolio Mangement Procurements
			651549.01.08				**JPL-Portfolio Management**
		651549.02					**Funded Research/Awards**
			651549.02.01				**ARC-Funded Research/Awards**
				651549.02.01.01			ARC-Labor and Travel
				651549.02.01.02			ARC-Core Competency Management
				651549.02.01.04			ARC-Biological Risk & Countermeasure
					651549.02.01.04.01		ARC-DNA Damage & Repair

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
					651549.02.01.04.02		ARC-Molecular Surveillance
					651549.02.01.04.03		ARC-High LET Radiation
					651549.02.01.04.04		ARC-Functional Role of Betaig-H3 Gene
					651549.02.01.04.05		ARC-HZE Particle-Induced Genetic
					651549.02.01.04.06		ARC-Mechanisms of Recombination
					651549.02.01.04.07		ARC-Bystander Effecst of High LET Rad
					651549.02.01.04.08		ARC-DNA Damage Responses
					651549.02.01.04.09		ARC-Fundamental Biological Studies
					651549.02.01.04.10		ARC-Mechanisms of High LET Rad
					651549.02.01.04.11		ARC-Free Radicals in Malignant Trans
					651549.02.01.04.12		ARC-Space Rad of Degenerative Tissue
					651549.02.01.04.13		ARC-Molecular and Cellular Effects
					651549.02.01.04.14		ARC-Simulated Hypergravity
			651549.02.02				**GRC-Funded Research/Awards**
				651549.02.02.01			GRC-Labor and Travel
				651549.02.02.02			GRC-Core Competency Management
			651549.02.03				**HQ-Funded Research/Awards**
				651549.02.03.01			HQ-Labor and Travel
				651549.02.03.02			HQ-Core Competency Mgmt/De-Scoping
			651549.02.04				**JSC-Funded Research/Awards**
				651549.02.04.01			JSC-Labor and Travel
				651549.02.04.02			JSC-Core Competency Management
				651549.02.04.03			JSC-Integrated Risk Assessment
					651549.02.04.03.01		JSC-Risk Assessment Project
					651549.02.04.03.02		JSC-Health Risks from High LET Radiation
					651549.02.04.03.03		JSC-Computational Modeling Chromosome Ab
					651549.02.04.03.04		JSC-Patterns of Energy Disposition by HZE
				651549.02.04.04			JSC-Biological Risk and Countermeasures
					651549.02.04.04.01		JSC-DOE Cooperative Radiation Research
					651549.02.04.04.02		JSC-NSCOR on solid Tumor Cancer Risk
					651549.02.04.04.03		JSC-Radiation Leukomegonesis NSCOR
					651549.02.04.04.04		JSC-Prog Alter of Centr Nerv Sys Structu
					651549.02.04.04.05		JSC-Lung Cnacer Pathogenesis and HZE Part
					651549.02.04.04.06		JSC-Autosomal Mutagenesis Vivo & In Vitr
					651549.02.04.04.07		JSC-Effect of Exposure to Heavy Parts

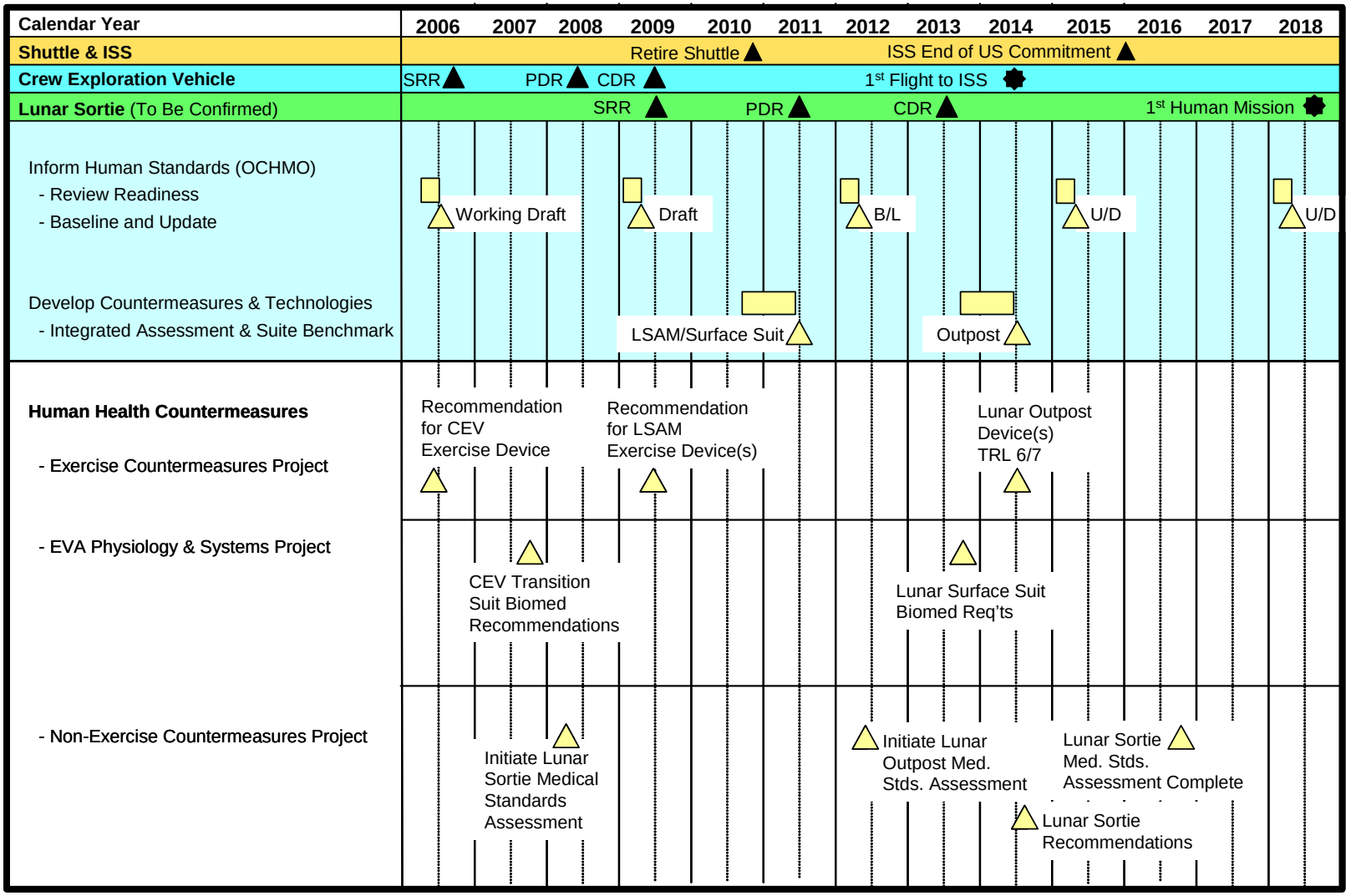
Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
					651549.02.04.04.08		JSC-Sp Rad Effect Neuroimaging NE-stern
					651549.02.04.04.09		JSC-DNA Dam Clusters in Human Cell Trans
					651549.02.04.04.10		JSC-Dose Resp Retinal Brain Corticle Mic
					651549.02.04.04.11		JSC-HZE Rad Effects Neuroinflammation
					651549.02.04.04.12		JSC-HZE Rad Modulation Genetic Effects
					651549.02.04.04.13		JSC-Impact of HZE Particle Exposure
					651549.02.04.04.14		JSC-In Vivo Ind of Chromosomal Dam
					651549.02.04.04.15		JSC-Individual Genetic Susceptibility
					651549.02.04.04.16		JSC-Non-inv Asses Neuropathology CNS
					651549.02.04.04.17		JSC-Dietary Retinoid Prevention of 56Fe
					651549.02.04.04.18		JSC-Selenomethionine Prot from Sp Rad
					651549.02.04.04.19		JSC-Mitigating High Z Rad Ind Genomic
					651549.02.04.04.20		JSC-Brain inflammation Particulate Irrad
					651549.02.04.04.21		JSC-Ionizing Radiation and Effects On
					651549.02.04.04.22		JSC-Mechanisms of Ocular Cataracts
					651549.02.04.04.23		JSC-Effect Estrogen Cataract Induction
					651549.02.04.04.24		JSC-Hum Endothelial Cells 2D & 3D Systems
					651549.02.04.04.25		JSC-Neurogenesis & Cognition in Human ApoE
					651549.02.04.04.26		JSC-Hololog ous recomb in complex DSP Rep
					651549.02.04.04.27		JSC-Precise Asses Prevelence Lens Opacit
					651549.02.04.04.28		JSC-Non-Cancer NSCOR
				651549.02.04.05			JSC-Measurement Technology Research
					651549.02.04.05.01		JSC-Cyrogenetic Study Heacy Ion-Induced
					651549.02.04.05.02		JSC-RT Meas of Dose & Charged Particle
					651549.02.04.05.03		JSC-Early Mark Sp Rad Induced Cataract
					651549.02.04.05.04		JSC-Monitor Rad-Induced Genetic Damage
					651549.02.04.05.05		JSC-MicroDosimeter iNstrument (MIDN) sys
				651549.02.04.06			JSC-Radiation Measurements & Trans Codes
				651549.02.04.07			JSC-Radiation Shielding Design Tools
				651549.02.04.08			JSC-Phased-out Grants & Contracts
			651549.02.05				**KSC-Funded Research/Awards**
				651549.02.05.01			KSC-Labor and Travel
				651549.02.05.02			KSC-Core Competency Mgmt/De-Scoping

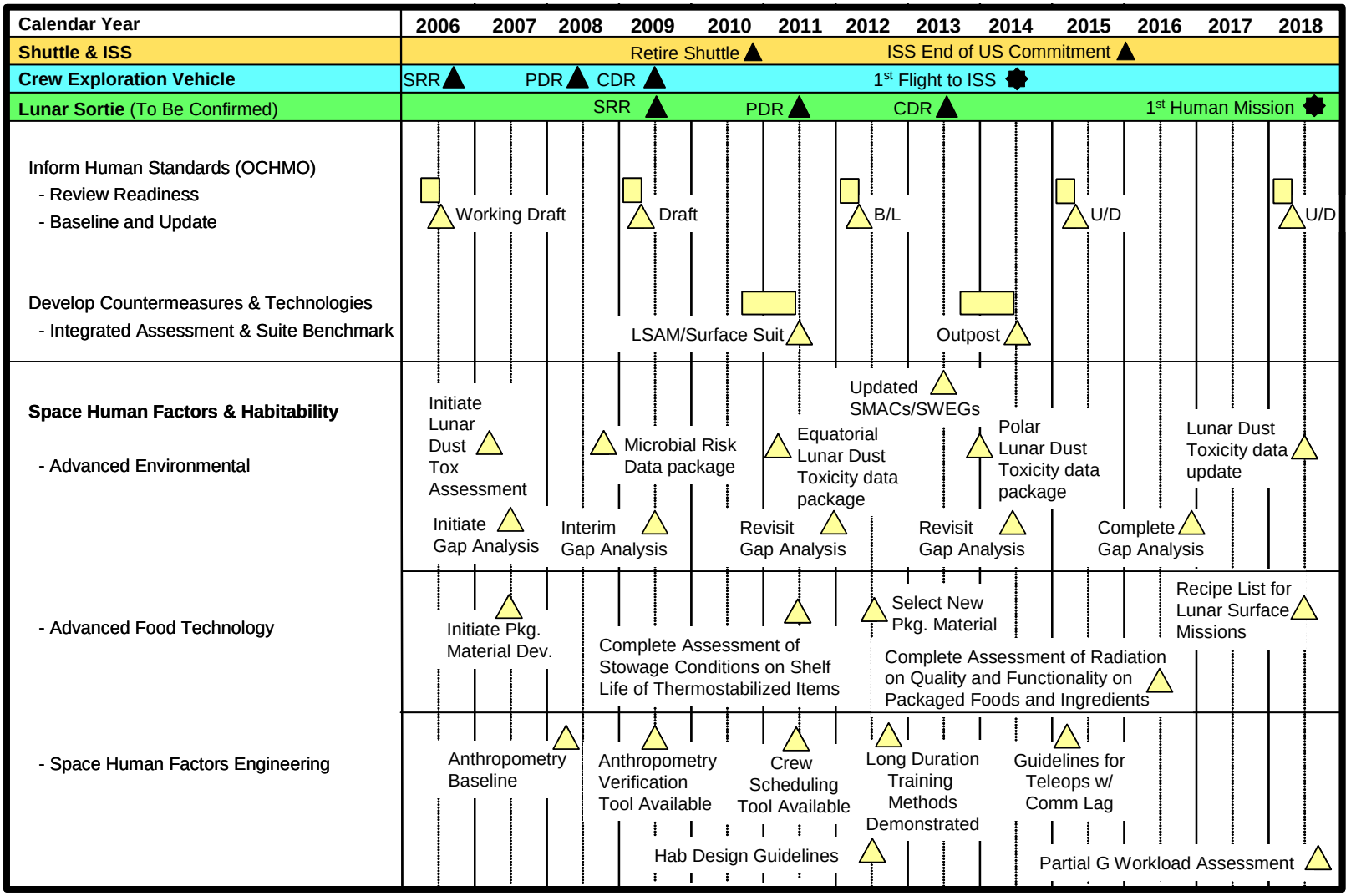
Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
			651549.02.06				**MSFC-Funded Research/Awards**
				651549.02.06.01			MSFC-Labor and Travel
				651549.02.06.02			MSFC-Core Competency Management
				651549.02.06.06			MSFC-Radiation Measurement & Trans Codes
					651549.02.06.06.01		MSFC-Meas of Frag Cross Sections
					651549.02.06.06.02		MSFC-Rad Transport Code Development
			651549.02.07				**LaRC-Funded Research/Awards**
				651549.02.07.01			LaRC-Labor and Travel
				651549.02.07.02			LaRC-Core Competency Mgmt/De-Scoping
				651549.02.07.03			LaRC-Integrated Risk Assessment
				651549.02.07.06			LaRC-Radiation measurements and Transpor
				651549.02.07.07			LaRC-Radiation Shielding Design Tools
			651549.02.08				**JPL-Funded Research/Awards**
		651549.03					**Facilities, Testbeds & Operations**
			651549.03.01				**ARC-Facilities, Testbeds & Operations**
			651549.03.02				**GRC-Facilities, Testbeds & Operations**
			651549.03.03				**HQ-Facilities, Testbeds & Operations**
			651549.03.04				**JSC-Facilities, Testbeds & Operations**
				651549.03.04.01			JSC-Brookhaven National Laboratory
				651549.03.04.02			JSC-Terminated Facilities
				651549.03.04.03			JSC-Loma Linda Proton Treatment Fac
				651549.03.04.04			JSC-Operations Integration
			651549.03.05				**KSC-Facilities, Testbeds & Operations**
			651549.03.06				**MSFC-Facilities, Testbeds & Operations**
			651549.03.08				**JPL-Facilities, Testbeds & Operations**
237A	**939924**						**Behavioral Health and Performance (BHP)**
		939924.01					**Portfolio Management**
			939924.01.01				**ARC-Portfolio Management**
				939924.01.01.01			ARC-Behavioral Health and Performance
				939924.01.01.02			ARC-Core Comptency Management
			939924.01.02				**GRC-Portfolio Management**
				939924.01.02.01			GRC-Behavioral Health and Performance
				939924.01.02.02			GRC-Core Competency Management
			939924.01.03				**HQ-Portfolio Management**

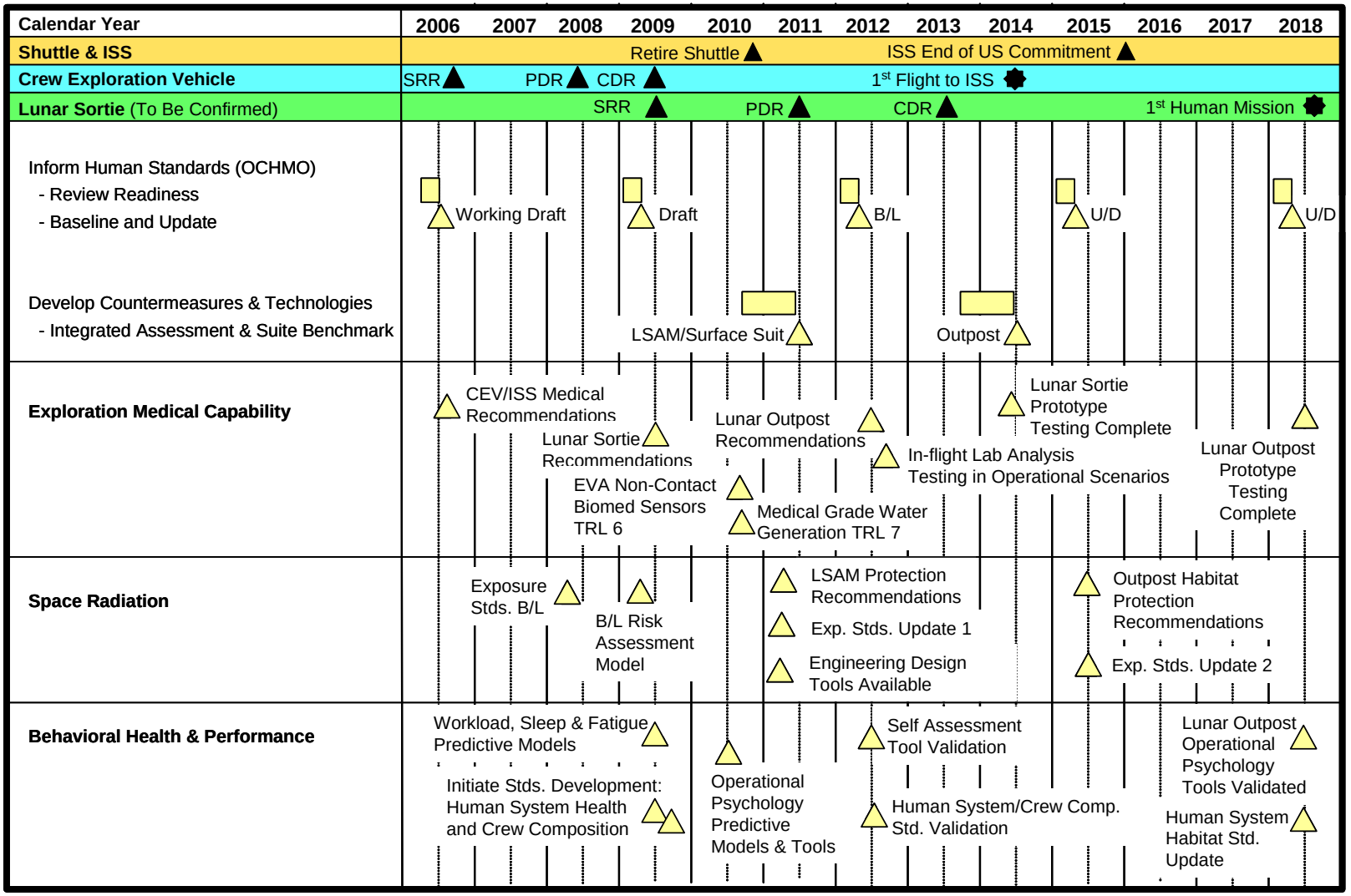
Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
			939924.01.04				**JSC-Portfolio Management**
				939924.01.04.01			JSC-Behavioral Health and Performance
				939924.01.04.02			JSC-Termination/De-Scoping Liability
				939924.01.04.07			JSC-ODIN & JIMMS Support
			939924.01.05				**KSC-Portfolio Management**
			939924.01.06				**MSFC-Portfolio Management**
		939924.02					**Funded Research/Awards**
			939924.02.01				**ARC-Funded Research/Awards**
				939924.02.01.01			ARC-Labor and Travel
				939924.02.01.02			ARC-Core Competency Management
			939924.02.02				**GRC-Funded Research/Awards**
				939924.02.02.01			GRC-Labor and Travel
				939924.02.02.02			GRC-Core Competency Management
			939924.02.03				**HQ-Funded Research/Awards**
				939924.02.03.01			HQ-Labor and Travel
				939924.02.03.02			HQ-Core Competency Management
			939924.02.04				**JSC-Funded Research/Awards**
				939924.02.04.01			JSC-Labor and Travel
				939924.02.04.02			JSC-Core Competency Management
				939924.02.04.04			JSC-BHP Team Cohesion & Productivity
					939924.02.04.04.01		JSC-BHP Issues - Long Duration
					939924.02.04.04.02		JSC-BHP Psychosocial Training - Kanas
				939924.02.04.05			JSC-BHP Behavioral Health Management
					939924.02.04.05.01		JSC-BHP Behavioral Health Medical Standa
					939924.02.04.05.02		JSC-BHP Clinical Cognitive Medical Stand
				939924.02.04.06			JSC-BHP Performance Readiness
					939924.02.04.06.01		JSC-BHP Mental Represent / Spatial Cues
					939924.02.04.06.02		JSC-BHP Sleep Wake Actigraphy and Light
					939924.02.04.06.03		JSC-CO-I Support for VOILA
					939924.02.04.06.04		JSC-BHP CogReadinessStnds3K&MedicalStnds
					939924.02.04.06.05		JSC-BHP Sleep and Fatigue Model - Dinges
					939924.02.04.06.06		JSC-BHP Circadian - Blue Light Activation
					939924.02.04.06.07		JSC-BHP Workload Standards
				939924.02.04.07			JSC-BHP SelectionIndicators&CrewAssembly
					939924.02.04.07.01		JSC-BHP Selection Standards Res Plan

Program	WBS 1	WBS 2	WBS 3	WBS 4	WBS 5	WBS 6	WBS Title
			939924.02.05				**KSC-Funded Research/Awards**
				939924.02.05.01			KSC-Labor and Travel
				939924.02.05.02			KSC-Core Competency Mgmt/De-Scoping
			939924.02.06				**MSFC-Funded Research/Awards**
				939924.02.06.01			MSFC-Labor and Travel
				939924.02.06.02			MSFC-Core Competency Management
		939924.03					**Facilities, Testbeds & Operations**
			939924.03.01				**ARC-Facilities, Testbeds & Operations**
			939924.03.02				**GRC-Facilities, Testbeds & Operations**
			939924.03.03				**HQ-Facilities, Testbeds & Operations**
			939924.03.04				**JSC-Facilities, Testbeds & Operations**
				939924.03.04.01			JSC-BHP Procurement Management
			939924.03.05				**KSC-Facilities, Testbeds & Operations**
			939924.03.06				**MSFC-Facilities, Testbeds & Operations**

APPENDIX D: HRP INTEGRATED MASTER SCHEDULE




Calendar Year
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Shuttle & ISS
Retire Shuttle
ISS End of US Commitment
Crew Exploration Vehicle
SRR
PDR
CDR
1st Flight to ISS
Lunar Sortie (To Be Confirmed)
SRR
PDR
CDR
1st Human Mission
Inform Human Standards (OCHMO)
- Review Readiness
- Baseline and Update
Working Draft
Draft
B/L
U/D
U/D
Develop Countermeasures & Technologies
- Integrated Assessment & Suite Benchmark
LSAM/Surface Suit
Outpost
Space Human Factors & Habitability
- Advanced Environmental
Initiate Lunar Dust Tox Assessment
Initiate Gap Analysis
Microbial Risk Data package
Interim Gap Analysis
Equatorial Lunar Dust Toxicity data package
Revisit Gap Analysis
Updated SMACs/SWEGs
Polar Lunar Dust Toxicity data package
Revisit Gap Analysis
Lunar Dust Toxicity data update
Complete Gap Analysis
- Advanced Food Technology
Initiate Pkg. Material Dev.
Complete Assessment of Stowage Conditions on Shelf Life of Thermostabilized Items
Select New Pkg. Material
Complete Assessment of Radiation on Quality and Functionality on Packaged Foods and Ingredients
Recipe List for Lunar Surface Missions
- Space Human Factors Engineering
Anthropometry Baseline
Anthropometry Verification Tool Available
Crew Scheduling Tool Available
Hab Design Guidelines
Long Duration Training Methods Demonstrated
Guidelines for Teleops w/ Comm Lag
Partial G Workload Assessment


Calendar Year
2006
2007
2008
2009
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2011
2012
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2014
2015
2016
2017
2018
Shuttle & ISS
Retire Shuttle
ISS End of US Commitment
Crew Exploration Vehicle
SRR
PDR
CDR
1st Flight to ISS
Lunar Sortie (To Be Confirmed)
SRR
PDR
CDR
1st Human Mission
Inform Human Standards (OCHMO)
- Review Readiness
- Baseline and Update
Working Draft
Draft
B/L
U/D
U/D
Develop Countermeasures & Technologies
- Integrated Assessment & Suite Benchmark
LSAM/Surface Suit
Outpost
Exploration Medical Capability
CEV/ISS Medical Recommendations
Lunar Sortie Recommendations
Lunar Outpost Recommendations
Lunar Sortie Prototype Testing Complete
In-flight Lab Analysis Testing in Operational Scenarios
EVA Non-Contact Biomed Sensors TRL 6
Medical Grade Water Generation TRL 7
Lunar Outpost Prototype Testing Complete
Space Radiation
Exposure Stds. B/L
B/L Risk Assessment Model
LSAM Protection Recommendations
Exp. Stds. Update 1
Engineering Design Tools Available
Outpost Habitat Protection Recommendations
Exp. Stds. Update 2
Behavioral Health & Performance
Workload, Sleep & Fatigue Predictive Models
Initiate Stds. Development: Human System Health and Crew Composition
Operational Psychology Predictive Models & Tools
Self Assessment Tool Validation
Human System/Crew Comp. Std. Validation
Lunar Outpost Operational Psychology Tools Validated
Human System Habitat Std. Update

APPENDIX E: PROGRAM RISK MANAGEMENT PLAN

E1. INTRODUCTION

E1.1 Purpose

The purpose of this plan is to document the process by which the Human Research Program (HRP) shall identify, assess, control and respond to risk factors that occur in the Program. It provides personnel across the elements and projects with a description of how the HRP shall manage risks. This Plan meets the intent of NPR 8000.4 and EXPLORATION-RMP-0001 for the HRP.

E1.2 Scope

This plan is applicable to the elements and projects that comprise the HRP. This plan is also applicable to associated contractors and any organizations external to the HRP that support the Program's risk management process.

The crew health and performance risks expressed in the Bioastronautics Roadmap are risks to flight programs, including the future operational lunar and Mars flight programs. The HRP functions to better define and mitigate those risks through its science management process. The HRP should define and manage risks related to achieving its baseline schedule, budget, and deliverable products.

This Plan does not cover risks identified when performing tasks for external Programs (i.e. STS, ISS, Constellation), such as trades, analyses, or other assessments. Risks identified as a consequence of those tasks shall be owned by the funding Program.

E2. DOCUMENTS

E.2.1 Applicable Documents

NPR 7120.5	Revision C	NASA Program and Project Management Processes and Requirements
NPD 8000.4	April 13, 2004	Risk Management Procedural Requirements with Change 1
EXPLORATION -RMP-0001	Version 1.0 April 11, 2006	Exploration Systems Risk Management Plan

E3. CONTINUOUS RISK MANAGEMENT

E3.1 Methodology

E3.1.1 Risk Identification

Risks shall be identified during daily activities of personnel, close call reports, lessons learned, meeting proceedings, programmatic level design and flight readiness reviews, etc. Risk statements shall be written, citing only one risk condition, and one or more consequences of that condition. Circumstances, contributing factors and other related issues should be captured. Good risk identification information should provide the what, how, when, where, and why of the risk condition. Each risk shall have a responsible person(s) assigned as owner.

E3.1.2 Risk Analysis

Each risk shall be evaluated as to the likelihood and the consequences of the risk. These can be estimated by using a scale of 1 to 5, where 1 is the lowest likelihood/least consequence, and 5 is the highest likelihood/consequence. The impact of the risk can then be determined from a matrix of the likelihood crossed with the consequence of the risk. This shall be displayed using the 5 x 5 matrix method.

E3.1.3 Risk Planning

As new risks are identified, a determination shall be made whether to retain responsibility for the risk, delegate responsibility, or transfer the risk responsibility to the appropriate team within the organization. Risks shall be assigned to the appropriate element or project for managing all aspects of the risk. The Program Manager may request transfer of a risk to an external organization if that organization is best suited to handle the risk.

E3.1.4 Tracking Risk

The person or office responsible for the risk shall provide routine status reports on mitigation activities to the Program Manager during regular meetings. A summary status report or detailed report should be generated for use at monthly reviews.

E3.1.5 Controlling Risk

During risk reviews, decisions shall be made to close risks, continue to research, mitigate or watch risks, re-plan or re-focus actions or activities, or invoke contingency plans. Mitigation plans are not to be used for possible resolutions, but for listing plans for dealing with the risk until a successful resolution can be found. The Program Manager authorizes and allocates resources to reduce risks. Once a risk has been mitigated down to a 2 x 2 on the risk matrix, it may be considered to be an Accepted Risk.

E3.2 Handling of Risks

Techniques for handling or controlling risks include:

- Avoidance: The Program, Element, or Project plan or approach is modified or project option is not selected in order to avoid or eliminate a risk
- Mitigation: Actions are taken by the Program, Element, or Project to reduce the likelihood of occurrence of an event or to reduce the severity of the impact if the event occurs
- Monitoring: The Program, Element, or Project decides to continue to monitor the event, without action, for later re-assessment and handling
- Transference: Ownership of a risk is transferred to another program, project, or organization that can more effectively handle the risk or for which the risk has a greater potential impact
- Acceptance: The Program, Element, or Project decides to accept the risk based on low likelihood of occurrence or low consequence.

Contingency plans shall be made where necessary to reduce the severity of impact should the adverse event, as identified by the risk, occur. The disposition of risks shall be continually reviewed as the projects progress and evolve to determine if the risk handling technique should be changed or if the risk can be retired.

E3.3 Risk Classification

Risks shall be analyzed using the Consequence and Likelihood classifications defined below. Consequence classifications, as defined in Table E-1, are based on ESMD requirements, mission success criteria, resources, cost and schedule, and safety constraints. Likelihood classifications, as defined in Table E-2, are intended to provide an order of magnitude estimate based on available quantitative data and qualitative experience.

E3.4 HRP Risk Reporting

The HRP Elements and Projects shall report program risk status to the Program as part of the quarterly reports for review by the HRPCB. The status of risks shall be presented using a standard 5 X 5 chart as shown in Figure E-1. The HRPCB shall be responsible for relaying HRP risk status to other affected organizations and programs.

Table E-1: Consequence Criteria Matrix for Assessment of HRP Risks

Classification		Consequence Criteria			
		Safety	**Schedule**	**Cost**	**Technical**
5	Very High	Condition may lead to death or permanent disabling injury, facility destruction, or loss of crew, major systems or vehicle	Slip in delivery to the flight program, slip in delivery of major system or subsystem beyond 6 months of milestone schedule	≥10% increase to HRP budget allocation	Loss of mission
4	High	Condition may cause severe injury or occupational illness, or major property damage to facilities, systems, equipment or flight hardware.	Delay of > 5 month ≤ 6 month for deliverables from milestone schedules	≥ 8% but < 10% increase to budget allocation	Loss of critical function or major science objective
3	Moderate	Condition may cause minor injury or occupational illness, or minor property damage to facilities, systems, equipment or flight hardware.	Delay of > 3 months < 5 months for deliverables from milestone schedules	>5% but <8% increase to budget allocation	Inability to meet power, weight, size and/or performance requirements; major science objectives not fully met
2	Low	Condition may result in minor first aid though would not adversely affect personal safety or health. Subjects facilities, equipment or flight hardware to more than normal wear and tear.	Delay of > 1 month ≤ 3 month for deliverables from milestone schedules	< 5% increase to budget allocation	Loss of design margins, some desired science objectives not met: some desired technical performance not completely met
1	Very Low	No impact to personnel or facilities.	Delay of ≤1 month for deliverables from milestone schedule	Minor impact to budget allocations	Small impact to design margins

Table E-2: Likelihood Classification Matrix for Assessment of HRP Risks

Likelihood of Occurrence	Description
5 -Very High (> 90% chance)	Occurrence is very likely and cannot be prevented by existing processes, procedures, and plans; no alternative approaches or processes are available.
4 -High (> 70% chance)	The existing processes, procedures, and plans cannot prevent this event, but a different approach or process may prevent the event.
3 -Moderate (40% to 70% chance)	The existing processes, procedures and plans may prevent this event, but additional actions shall be required.
2 -Low (10 % to 39% chance)	The existing processes, procedures, and plans are usually sufficient to prevent this type of event.
1 -Very Low (< 10% chance)	The existing processes, procedures, and plans are sufficient to prevent this event.

Identify and Assess Risk

1 **Start with a Concern.** Is this a program risk?
- What information is available? Gather information: requirements status, problem data, trends, hazards, critical items, history, etc.

2 **Define Risk Statement.**
- Given the condition (A), there is a possibility that (B) shall occur.

  (A) – Single phrase briefly describing current key circumstances or situations that are causing concern, doubt, anxiety or uncertainty.

  (B) – Consequence or impacts of the current conditions that could be realized due to (A)

3 **Define the Consequences (B).** Locate the most accurate description(s) among the Safety, Mission Success, Supportability, Cost and Schedule consequence descriptions.

4 **How likely is the risk scenario?** Locate the most accurate Likelihood description that corresponds to the risk statement. Only one Likelihood score is possible. Note: Quantitative likelihood ratings refer to program lie and are provided as guidelines only.

5 **Plot the Risk.** Select the highest consequence score. Plot this against the ONE Likelihood score on the RED/YELLOW/GREEN risk matrix.

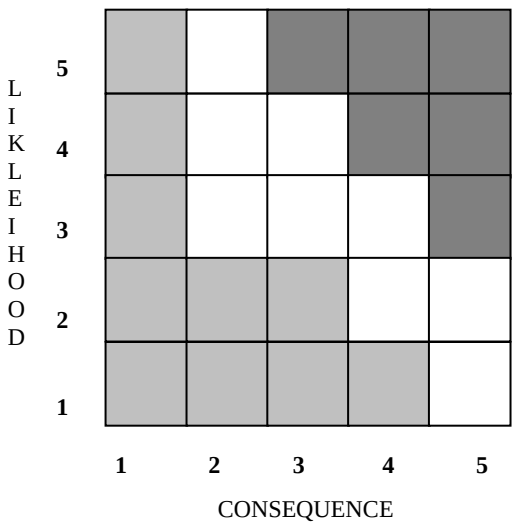

Figure E-1: HRP Risk Management Scorecard

E4. HRP RISK MANAGEMENT PROCESS

E4.1 Process Overview

The content of the HRP shall be based on striking a balance between crew health risks and budgeted program resources. The overall process for defining program content is shown in Figure E-2.

E4.2 Identification and Assessment of Crew Health Risks

The primary technical risks for the HRP are identified in the Bioastronautics Roadmap. These risks are grouped by physiological discipline (e.g., cardio vascular alterations, bone loss, nutrition) and by mission (ISS, Lunar, Mars). The Science Management Office shall further rank these risks in order of priority against the Design Reference Missions, Mission Architectures, and Mission Requirements being developed by the Constellation Program. Priority shall be based on multiple factors, including probability of occurrence, mission impacts, and crew health impacts.

This process shall identify the highest risks for each mission, which shall drive the focus of the Program content. This list shall be reviewed periodically (at least annually) as new information is provided by the research projects or as Constellation needs change.

E4.3 Identification and Assessment of Program Risks

Programmatic risks are driven by technical risks, budget constraints, and the program schedule. The Program Integration Office (PIO) shall assess the prioritized list of technical risks and the required resources (e.g., cost, schedule, facilities) against the budgeted resources for the Program. Higher-priority tasks that cannot be adequately funded, or for which there are inadequate resources, constitute program risks. From this, the proposed Program content and risks shall be developed.

The proposed content shall be subjected to a Risk Assessment Review to ensure the content adequately addresses the prioritized technical risks and to re-allocate resources where needed. Once approved by the Program Manager, the content shall be baselined and flowed down to the various Elements and Projects.

Program content shall be reviewed annually based on updated risk assessments. Research tasks shall be continued, re-directed, or terminated based on technical progress, budget limitations imposed during the annual Planning, Programming, Budgeting, and Execution (PPBE) process, or as Constellation needs change.

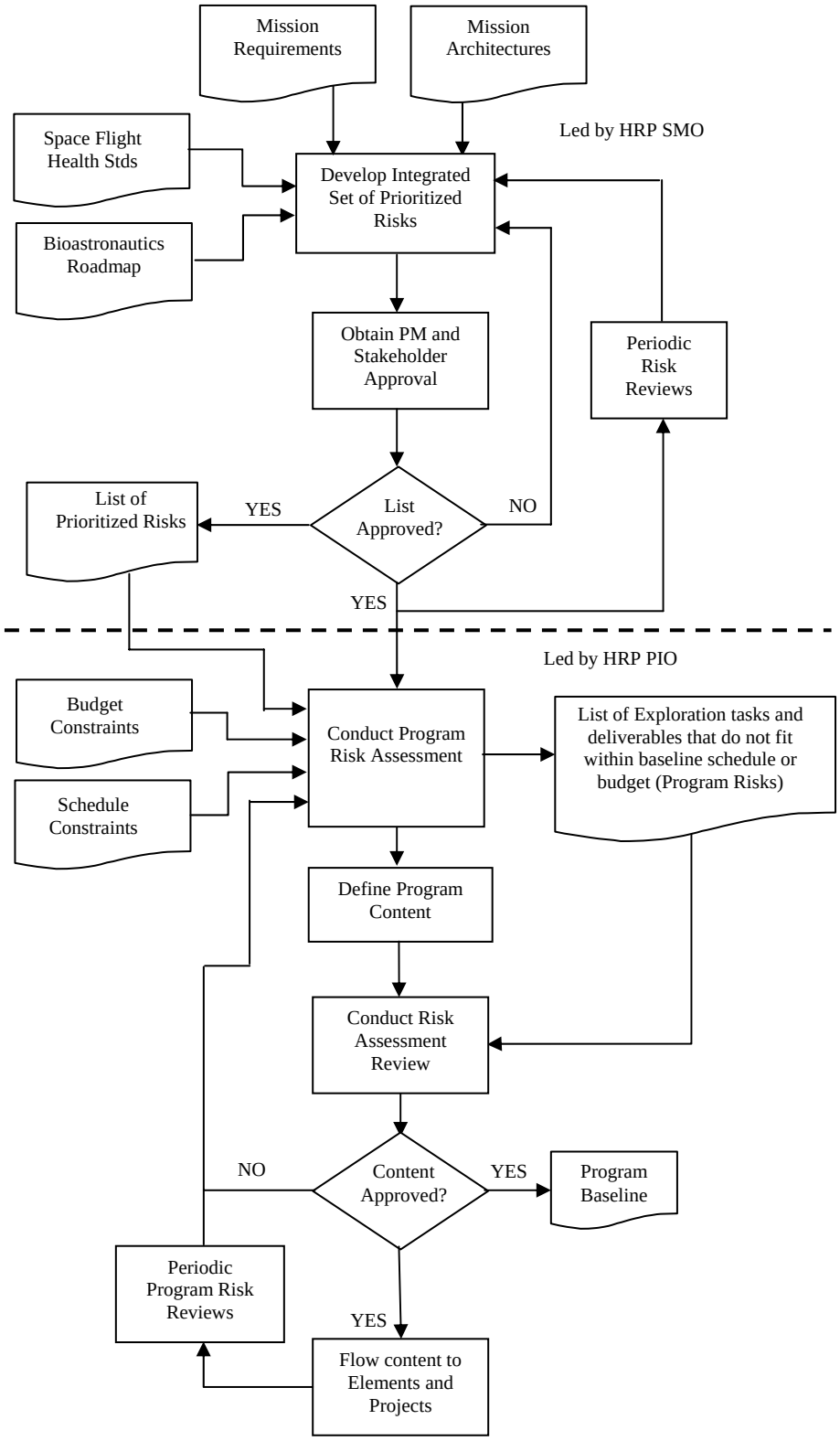

Figure E-2: Program Risk Assessment and Content Definition Process

E4.4 Communicating Program Risks

Successful risk management relies upon:

- Open communications at and among all organizational levels
- Continuously addressing areas that may potentially cause future problems
- Continuously assessing risks and strategies to mitigate those risks

At a minimum, elements and projects shall report cost and schedule status to the Program Manager on a monthly basis as part of the Monthly Activity Report (MAR). Status shall also be reviewed at the HRP Control Board (HRPCB) for high risk tasks or unforeseen events that impact program risks.

A more complete review of element and project status shall be conducted on a quarterly basis as part of the Program Technical, Cost, and Schedule Review (TCSR) with an emphasis on impacts to program risks. The PIO shall re-assess program risks and report status to the Program Manager on a quarterly basis. Top program risks shall be reported to the affected organization or program HRPCB. The HRP shall also report high level risks, dispositions, and status to the ESMD AA.

E4.5 Documenting Program Risks

The HRP shall use the HRP Integrated Risk Management Application (HRP IRMA) as the common database for documenting and tracking program risks. From the HRP IRMA, risks shall be transported to other program databases, as appropriate; the ESMD Active Risk Manager (ARM), the JSC Center IRMA for Center-related risks, the ISS Program IRMA for all ISS-unique risks, and the Space Shuttle Program IRMA for all Shuttle-specific risks.

The ESMD provides a common database, ARM, for risk management. The HRP shall use ARM to track top Program risks and those risks that affect other ESMD programs.

APPENDIX F: CURRENT HRP EXTERNAL AGREEMENTS

#	PR Number	Subject / Type	Partners	Effective Date	End Date
1		Vestibular Function	NIH – NIDCD	Oct-92	Continuing
2	10-04602	Studies of Sensory-Motor Functions Responsive to Gravity in Genetically Altered Model Systems	NIH – NIDCD	Oct-00	Continuing
3		Research into Processes of Aging and Space Flight	NIH – NIA	Sep-97	Continuing
4		Research into Processes of Aging and Space Flight	NIH – NIA	Sept-92	Continuing
5		Establish Collaborative Science Planning and Cooperative Support in Areas of mutual Research	NIH - NCRR	Sept-94	Continuing
6	10-03900	Cancer Research	NIH - NCI	Jul-94	Continuing
7		Musculoskeletal Research	NIH - NIAMS	Dec-92	Continuing
8		Cardiovascular, Pulmonary and Hematologic Studies	NIH - NHLBI	Sept-93	Continuing
9	10-72437	SPACELINE – National Library of Medicine	NIH – NLM	Dec-93	Continuing
10	10-06451	Space Life Sciences Database - on World Wide Web	NIH – NLM	Aug-01	Continuing
11		Biomedical/Behavioral Research	NIH	May-99	Continuing
12		Neurologic Functions	NIH – NINDS	Nov-92	Continuing
13	10-03479	Applications of Robotics to Neuromuscular Adaptations	NIH – NINDS	Feb-00	Continuing
14	10-03481	Collaboration on Studies and Workshops between NASA and NIH	NIH - NINDS	Mar-00	Continuing
15	42-22656	Human Frontier Science Program	The White House	Jul-03	Sep-03
16		Space Radiation Health Program	DOE	Jul-92	Continuing
17	4200109053 W-10.081, Mod #4	Establish Formal Scientific Collaboration between NASA and DOE - OBER	DOE – OBER	Jan-02	Continuing
18	10-01234	Radiobiology Heavy Ion Beam Research	DOE - BNL	Apr-94	Continuing
19	10-04530				
20	10-02731	Expertise Exchange in Musculoskeletal and Exercise Physiology	ACSM	Sept-99	Continuing
21	10-04571	John Glenn Scholarship for Space Research	AFAR	Jun-00	Continuing
22		Remote Sensing and Disease Prediction	NCID-CDC	Jul-95	Continuing
23		Enhance the Application of Remote Sensing and Geographic Information Systems to Areas of Infectious Disease Surveillance	NOAA - OGP	Apr-00	Continuing

#	PR Number	Subject / Type	Partners	Effective Date	End Date
24		Foster New Areas of Cooperation between USDA and NASA	USDA	Jan-01	Jan-11
25		Enhance the Application of Remote Sensing & Geographic Information Systems Technology	USGS – EDC	Nov-99	Continuing
26		Water Reclamation	DOD-Navy	3-Jan-05	Continuing
27		UTMB Testbed Facilities	NIH	24-Jan-05	Continuing
28		Multi-Scale Modeling	NSF,NIH,DOE	5-May-04	Dec-06
29		Plant Research	Dept Agriculture	23-Jan-01	Jan-11
30		Flight Food Systems	DoD-Soldier Systems Center	14-Dec-01	Continuing
31	NNJ05HD94I	DoD Human Factors Engineering Technical Activity Group (TAG)	US Army Research, Development and Engineering Command, Army Research Laboratory	10-May-05	15-May-06
32		International Multidisciplinary Artificial Gravity (IMAG) Project Pre-Phase I and Phase I Agreement	DLR (German Aerospace Center) and RAS (Russian Academy of Sciences)	13-Oct-04	13-Oct-07
33		US / Russian Joint Working Group on Space Biomedicine, Life Support Systems, and Microgravity Sciences	Russian Institute of Biomedical Problems (IMBP)	1-Apr-94	Continuing
34		International Space Life Sciences Flight Experiments on the ISS (ISLSWG)	ESA / CSA / JAXA	Sept-02	Sept-12
35		All Female Long Term Head-Down Tilt Bed Rest Study	ESA / CNES / CSA	Jul-04	Jul-09

APPENDIX G: NPR 7120.5C COMPLIANCE MATRIX

Program/Project Name: Human Research Program	**Date:** February 2006
Program/Project Manager: Kathy Laurini, Johnson Space Center, Space Life Sciences Directorate	
Requirement	**Compliant (Yes/No)**
2 CHAPTER 2. Program Management Requirements	Title
2.1 Four-Part Program Management Process	Title
2.1.a As a strategic management structure, the program construct is extremely important within NASA. Programs provide the critically important linkage between the Agency's ambitious goals and the projects that are the instruments for achieving them. Programs vary significantly in scope, complexity, cost, and criticality; however, a properly designed and executed program structure inevitably contributes to sound project management being embraced and practiced at lower levels. To initiate individual programs, a Mission Directorate (or Mission Support Office **shall** prepare a program Formulation Authorization Document (FAD).	FAD not required. HRP content was previously in HSRT.
2.1.b The Program Manager is responsible for ensuring that program goals address the Mission Directorate Strategies and Mission Support Office Functional Leadership Plans and that the program's content, which may contain multiple product lines, addresses those program goals. The Program Manager **shall** be responsible for recommending to the MDAA (or MSOD) the appropriate product line for each project in his/her program. The Program Manager coordinates program content with the Mission Directorate (or Mission Support Office), provides leadership, and is responsible for the successful accomplishment of the program that meets the needs of the customer. This chapter further delineates the management requirements for programs, described in terms of the four-part management process of paragraph 1.7.1. Program Managers **shall** meet all requirements outlined in this chapter *irrespective of the size of the program*.	Yes
2.2 Program Formulation	Title
2.2.1 Purpose: The purpose of program formulation activities is to establish a cost-effective program that is demonstrably capable of meeting Agency and Mission Directorate (or Mission Support Office) goals and objectives. The program Formulation Authorization Document (FAD) authorizes a Program Manager to initiate the planning of a new program, and to perform the analyses required to formulate a sound Program Plan. A FAD template is found in Appendix A. The PCA is the agreement between the MDAA (or MSOD) and the NASA Deputy Administrator that authorizes transition from formulation to implementation. A PCA can be considered an executive summary of the Program Plan. A PCA template is found in Appendix B.	Not a "shall" statement
2.2.2 Requirements: During program formulation the Program Manager, once selected, **shall**:	See subparagraphs
2.2.2.a Prepare a Program Plan	Yes
(1) In the Program Plan the Program Manager **shall** define and document an affordable program architecture along with the success criteria and performance metrics. (A Program Plan template is provided in Appendix C.) Specifically, the Program Manager **shall**:	Yes
(i) Ensure that top-level requirements, including success criteria, for each constituent project are defined in coordination with the Mission Directorate (or Mission Support Office) and documented in the Program Plan.	Yes
(ii) Ensure the validated top-level requirements and program success criteria flow down to projects or portfolios. Program Managers are required to demonstrate this linkage (traceability) while formulating and implementing a program, and this linkage shall be closely monitored when the Program Plan is reviewed.	Yes

Requirement	Compliant (Yes/No)
(iii) Prepare estimates of yearly New Obligational Authority (NOA) consistent with top-level program requirements, and identify the civil service workforce so as to enable full cost estimates.	Yes
(iv) Prepare an overall program timeline with key milestones related to the accomplishment of program goals and objectives. When applicable, the timeline should provide guidance and a schedule for the announcement of new project (or research) opportunities.	Yes
(v) Document synergistic activities with other NASA, industry, academia, and international programs.	Yes
(vi) Prepare and implement a comprehensive Safety and Mission Assurance (SMA) Plan early in program formulation to ensure program compliance with all regulatory safety requirements from OSHA and all NASA Safety and Mission Assurance requirements such as mishap reporting and investigation, range safety, software safety and assurance, and human rating requirements. The importance of up-front safety, reliability, maintainability, and quality assurance requirements should be emphasized in all program activities.	Yes
(2) Beginning early in program formulation, the Program Manager **shall** work with the Office of External Relations, the Deputy Chief Acquisition Officer, and the MDAA (or MSOD) to identify potential non-NASA partners and necessary agreements for international or interagency cooperation.	Yes
(i) All activities and documentation **shall** be consistent with policy directives and with Mission Directorate (or Mission Support Office) and Agency-level agreements with the partners.	Yes
(ii) All program-enabling commitments **shall** be obtained prior to program approval for implementation.	Yes
(3) The Program Manager **shall** evaluate lessons learned from existing and previously executed programs and projects to identify applicable lessons for use in program planning and execution.	Yes
(4) Early in program formulation, the Program Manager, in consultation with the MDAA (or MSOD), **shall** recommend a Technical Warrant Holder (TWH). The NASA Chief Engineer selects the TWH.	Yes
2.2.2.b Create a program organizational and financial structure.	Yes
(1) The Program Manager **shall** build a program organizational structure that assigns clear lines of responsibility, authority, and accountability to specific Centers, Project Managers, partners, advisory groups, and oversight boards.	Yes
(2) Working in close cooperation with the OCFO, the Program Manager **shall** be responsible for creating financial management structures that comply with budget and accounting standards established by that Office.	Yes
2.2.2.c Develop a program technical approach.	Yes
(1) As applicable, the Program Manager **shall** identify scientific and engineering research and development strategies, develop constituent project (systems and operations) concepts, acquisition strategies, technology strategies, commercialization plans, agreements (e.g., space operations service agreements, launch services agreements, safety and mission assurance agreements) and logistics concepts, and incorporate them into the Program Plan. The most important aspect of this formulation activity is conducting a thorough analysis of alternatives (AoA), relying on architecture frameworks, program-level systems engineering, design reference mission analysis, and other formal techniques.	Yes
(2) The Program Manager **shall** establish the program's methods for advanced technology insertion and validation, safety and mission assurance, environmental impact assessment, records and data management and distribution, physical and information security and program protection, and risk management, and incorporate them into the Program Plan.	Yes
(3) The Program Manager **shall** incorporate the security considerations in NIST Special Publication 800-64, "Security Considerations in the Information System Development Life Cycle" in the lifecycle of all Information Technology related Programs.	Not an IT program.
2.2.2.d Develop a continuous risk management process.	Yes

Requirement	Compliant (Yes/No)
(1) The Program Manager **shall** develop and implement a continuous risk management process (that includes integrated risk management planning for all risks associated with program safety, cost, schedule, and technical performance), and document it in a program Risk Management Plan.	Yes See Appendix C
(i) The Program Manager **shall** begin the process with risk identification and an assessment of program constraints, which defines the acceptable risks. Areas of potential program risks include, but are not limited to: mission success criteria; development schedule; budget limits; launch window and vehicle availability; international partner participation; critical single source suppliers; security; environmental concerns; human space flight safety issues; fail ops/fail safe requirements; safe and reliable operations; and the amount and type of testing.	Yes
(ii) The Program Manager **shall** follow the NASA Continuous Risk Management (CRM) Process, shown as Figure 2-1 and Figure 3-2 in Chapter 3.	Yes
(iii) The program Risk Management Plan **shall** describe periodic risk reviews, system safety, quantitative risk assessments, operations risk management, risk-based acquisition management, and information management systems for problem reporting, surveillance reporting, supportability data and trends analyses	Yes
(2) All risks **shall** be documented and communicated throughout the program life cycle.	Yes
(3) The results of the risk management process **shall** be incorporated into the final technical products.	Yes
2.2.2.e Develop a closed-loop problem tracking process that includes problem or anomaly reporting, problem analysis, and corrective action.	N/A Not a flight hardware program
(1) The Program Manager **shall** develop a protocol to review past performance to determine the incidence of identical or related anomalies.	N/A Not a flight hardware program
(2) The Program Manager **shall** develop an escalation procedure (to inform higher levels of management) based on mission criticality.	N/A Not a flight hardware program
(3) The Program Manager **shall** develop a closeout process for root cause determination, anomaly mitigation, and recurrence control.	N/A Not a flight hardware program
(4) The Program Manager **shall** evaluate and disposition Government-Industry Data Exchange Program (GIDEP) Alerts, Safe-Alerts, Problem Advisories, Agency Action Notices and NASA Advisories, and **shall** exchange significant problem and nonconforming item data with other activities and with GIDEP.	N/A Not a flight hardware program
2.2.2.f Present the Program Plan for approval by the MDAA (or MSOD).	Yes
(1) Prior to the program Non-Advocate Review (NAR), the Program Manager **shall** secure Program Plan concurrence by the cognizant MDAA (or MSOD) and from those Center Directors committing support to the program.	N/A NAR or equivalent previously conducted
(2) For single-project programs, the Program Manager **shall** either prepare both a Program Plan and a Project Plan, or integrate key elements of the Program Plan with all required elements of the Project Plan. The resultant Program Plan should fully meet the requirements described for both the program and project plans, including adequate linkage to the Agency Vision, goals, and objectives.	N/A HRP has multiple projects.
(i) For the purposes of compliance with this document, formulation and implementation activities for single-project programs **shall** follow the requirements outlined for projects.	N/A HRP has multiple projects.

Requirement	Compliant (Yes/No)
(ii) A Formulation Authorization Document (FAD) and a Program Commitment Agreement (PCA) **shall** be required for a single-project program.	N/A HRP has multiple projects.
2.2.2.g Support the Mission Directorate or the (Mission Support Office) in the preparation of a Program Commitment Agreement, based on the content of the Program Plan.	Yes
2.3 Program Approval	Title
2.3.4 Requirements: In support of Agency PMC decision review meetings during program approval:	Not a "shall" statement
2.3.4.a The Program Manager **shall** support evaluation by IPAO in accordance with the program evaluation process. (See paragraph 2.5.8 for more detailed requirements.)	Yes
2.3.4.b The Program Manager **shall** prepare a program readiness overview briefing for presentation at the Agency PMC milestone decision review meeting that includes a summary of the program, the status of program documentation and products, concurrence of the TWH on technical requirements (including all variances), and significant risks, all appropriate to the level of program maturity.	Yes As appropriate for an already established program
2.3.4.c The Program Manager **shall** prepare (and/or submit) the program documents and products described in Table 2-2. For programs that have a preliminary NAR, an updated FAD is not needed for the NAR.	Yes See 2.1a above regarding FAD.
2.3.4.d At that meeting, the IPAO results and findings, including an Independent Cost Analysis (ICA), are also presented. The Program Manager **shall** then follow with a presentation of responses to the IPAO findings.	Yes
2.4 Program Implementation	Title
2.4.2 Program Control	Title
2.4.2.2 Requirements: During implementation, the Program Manager **shall**:	See subparagraphs
2.4.2.2.a Have a signed PCA before conducting activities associated with program or program element (project or portfolio) implementation.	Yes, as appropriate for an already established program
2.4.2.2.b Demonstrate a comprehensive program control function.	Yes
(1) The program control function **shall** operate to ensure that cost, schedule, safety, and performance commitments made at the program and project levels are demonstrable in terms of agreed-upon metrics.	Yes
(2) The Program Manager **shall** focus attention on assuring that projects are operating within the framework of the approved Program Plan.	Yes
(3) The Program Manager **shall** monitor any program element reserves held at the program level and distribute them, as needed, to meet program goals and objectives.	Yes
2.4.2.2.c Prepare and maintain detailed budgets, work authorizations, plans, and schedules.	Yes
(1) The Program Manager **shall** provide a copy of the signed PCA to the OCE and OCFO.	Yes
(2) The Program Manager **shall** support the Mission Directorate (or Mission Support Office) in updating the PCA through a revision when new content is added to the program (e.g., the creation of a new project); the revision **shall** be noted in the PCA change log.	Yes

Requirement	Compliant (Yes/No)
(3) The Program Manager **shall** evaluate the need for modifications of the Program Plan and the PCA due to changes in projects and activities within the program. Programs are usually long-lived constructs and should not require extensive modification during implementation. However, external funding changes or strategic shifts within the Agency can generate modifications to the PCA. Specifically, for ongoing programs:	Yes
(i) The Program Manager **shall** support the Mission Directorate (or Mission Support Office) in updating the PCA through a modification when budget changes greater than 20 percent (20%) in a given year, or ten percent (10%) within a five-year horizon, occur.	Yes
(ii) The Program Manager **shall** support the Mission Directorate or (Mission Support Office) in preparing the PCA modifications and documenting them in the PCA change log. The Mission Directorate shall approve the modifications and take the modified PCA to the Agency PMC for an approval recommendation to the Deputy Administrator.	Yes
(iii) The Program Manager **shall** support the Mission Directorate (or Mission Support Office) in preparing a briefing for the Agency PMC that describes factors driving the modification and **shall** support the briefing if requested. When the Deputy Administrator signs the modified PCA, the program modification is approved.	Yes
(4) Budget data **shall** reflect, at all times, the full cost of implementing all aspects of the program. (For more information on full cost and practices, see Volume 7 of the NASA Financial Management Requirements.)	Yes
(5) The Program Manager **shall** prepare and maintain a detailed schedule of program milestones and major planned events. Program Managers are encouraged to identify alternative development paths in order maximize the probability of success.	Yes
(6) The Program Manager **shall** review and approve constituent Project Plans.	Yes
2.4.2.2.d Oversee acquisition efforts.	Yes
(1) The Program Manager **shall** ensure that all acquisition efforts[1] and other transactions are implemented in accordance with Federal law and regulations (including the FAR or OMB Circulars, as applicable), and the NASA FAR Supplement, NASA directives, and the Program Plan.	Yes
(2) The Program Manager **shall** ensure that standards and requirements flow down to external parties (i.e., contractors, grantees, and non-NASA parties to Space Act and other agreements and non-procurement instruments).	Yes
2.4.2.2.e Conduct an integrated continuum of reviews. The Program Manager **shall** conduct the internal program reviews during implementation as specified in the Program Plan.	Yes
2.4.2.2.f Disposition all risks before delivery to operations (or the equivalent for a technology program).	Yes
2.4.2.2.g Support the Mission Directorate (or MSO) in preparing material for Quarterly Status Reviews (QSRs) to the Agency PMC.	Yes
2.4.2.2.h Periodically evaluate the performance of Project Managers and their teams.	Yes
2.4.3 Program Advocacy	Title
2.4.3.2 Requirements: During implementation, the Program Manager **shall**:	See subparagraphs
2.4.3.2.a Advocate and promote customer involvement in the implementation of the program to assess progress against commitments.	Yes

[1] This includes contracts, grants, cooperative agreements, interagency agreements, Space Act Agreements, and any effort not performed by NASA installation employees.

Requirement	Compliant (Yes/No)
2.4.3.2.b Produce and execute a plan for education and public outreach by working with Mission Directorate education leads and the NASA Office of Education.	Yes, within budget limitations
2.4.4 Program Integration	Title
2.4.4.2 Requirements: During implementation, the Program Manager **shall**:	See subparagraphs
2.4.4.2.a Maintain the continuity of requirements by ensuring that requirements are fully traceable from Agency vision and goals down through program requirements and top-level project requirements.	Yes
2.4.4.2.b Ensure that the program is being implemented in a cost-effective manner by continuing to conduct architecture trades, technology assessments, mission analyses, and infrastructure and operational analyses that help structure program-level investments for maximum return.	Yes
2.4.4.2.c Ensure that all investment areas (product lines) associated with the program are being managed in an integrated manner so that changes in one program investment area are reflected in all other related investment areas.	Yes
2.4.4.2.d Ensure that all cross-cutting management elements of the program (e.g., safety, technology strategy, risk management) are being implemented in constituent projects in accordance with the Program Plan.	Yes
2.4.4.2.e Identify and secure facilities, infrastructure, equipment (including GFE), materials, supporting personnel, and services that are required to support multiple projects within the program.	Yes
(1) The Program Manager **shall** negotiate agreements with support providers, as needed.	Yes
(2) For those products requiring transfer of custodial responsibility, the Program Manager **shall** ensure that acceptance/turnover activities, licensing, and documentation are addressed.	Yes
(3) The Program Manager **shall** ensure that Project Plans account for the disposition of assets (orbital and other) after the end of their useful life.	Yes
(4) The Program Manager **shall** manage all salvageable assets (e.g., spares) remaining at the end of a constituent project's life cycle.	Yes
2.5 Program Evaluation	Title
2.5.8 Requirements: To accomplish the on-going program evaluation process, the Program Manager **shall**:	See subparagraphs
2.5.8.a Plan program team and schedule resources to support Independent Assessment (IA) for all required program decision reviews and Program Implementation Reviews (PIRs) (nominally every two years after the NAR approval). For initial planning purposes, the Program Manager should consult Table H-2 in Appendix H. The program's planning schedule may be modified through negotiation with the IPAO.	Yes
2.5.8.b Comply with the evaluation Terms of Reference (ToR) for all independent reviews.	Yes
(1) The ToR is prepared by the IPAO through negotiation with the MD (or MSO) point-of-contact. The ToR is approved by the OCE and the MDAA (or MSOD). The ToR specifies the details of conducting site field review events, including the schedule, deliverable items and areas of program risk. If the MD (or MSO) point-of-contact and the IPAO cannot agree on the ToR scope and content, the OCE **shall** be the final decision authority.	Yes
(2) The final schedule **shall** be documented in the evaluation Terms of Reference (ToR).	Yes
2.5.8.c Prepare program briefings and material demonstrating the program's readiness to continue, and present them at the IPAO site field review. These briefings **shall** include a program cost estimate. (PIRs are designed to measure program performance and compare that performance against the Program Plan. Consequently, the biennial PIR focuses on program activities and generally does not delve into project operations. The Program Manager should, however, plan for some level of project-level analysis in order to assess the delivery of products and services according to the agreed-upon metrics in the Program Plan.) The Program Manager should consult Table H-1 in Appendix H for other assessment criteria.	Yes

Requirement	Compliant (Yes/No)
2.5.8.d Review facts, assumptions, and findings of the initial IPAO briefing, and provide a formal response to the IPAO.	Yes
2.5.8.e Comply with external requests for evaluation and audit (e.g., the Congress, OMB, the NASA Inspector General, GAO, etc.).	Yes
2.5.8.f Support any additional independent reviews or technical assessments that may be required during formulation and implementation as directed by the Administrator, Agency PMC, MDAA, MSOD, the OCE (including the NESC), or the Office of Safety and Mission Assurance. The Program Manager **shall** provide formal responses to action items/recommendations from these reviews for closure.	Yes
2.5.8.g Ensure that program engineering data related to failures, anomalies, evaluations, problems, incidents, and Requests for Action (RFAs) are captured, retained, and made available to the TWH and NESC upon request.	Yes
2.5.8.h Provide support for a Safety and Mission Assurance Readiness Review (SMARR) prior to any launch or safety critical event or other activity selected by the Chief SMA Officer.	Yes
4 CHAPTER 4. Basic and Applied Research Portfolios	Title
4.2 Portfolio Formulation	Title
4.2.b During formulation the Portfolio Manager performs and orchestrates the following activities:	Not a “shall” statement
4.2.1 Portfolio Planning Requirements: The MDAA- or MSOD-designated Portfolio Manager **shall**:	See subparagraphs
4.2.1.a Prepare a Portfolio Process Plan.	Yes
(1) At a minimum, the Portfolio Process Plan **shall**:	See subparagraphs
(i) Define and document portfolio objectives that support Agency, Theme, and program goals. The Portfolio Manager coordinates with the cognizant MDAA (or MSOD) and Program Manager.	Yes
(ii) Define a process for the solicitation, evaluation, and selection of proposals (including identifying Selection Official(s)).	Yes
(iii) Establish evaluation criteria including considerations of quality, relevance to NASA missions and strategic goals, and performance.	Yes
(iv) Include an integrated portfolio budget typically for three or five years (including appropriate WBS elements).	Yes
(v) Include a multi-year schedule for the portfolio.	Yes
(vi) Include portfolio evaluation processes.	Yes
(2) Create a management and control structure to implement the Portfolio Process Plan.	Yes
4.2.1.b Obtain approval of the Portfolio Process Plan. The Portfolio Manager **shall** forward the Portfolio Process Plan to the Program Manager for approval.	Yes
4.2.2 Proposal Solicitation, Evaluation, and Selection Requirements: The Portfolio Manager **shall**:	Yes

Requirement	Compliant (Yes/No)
4.2.2.a Initiate solicitation and receipt of proposals through the issuance of a Broad Agency Announcement following the process established in the approved Portfolio Process Plan. Prospective PIs participate in portfolio formulation by preparing and submitting proposals in response to a solicitation. Research proposals for individual investigations include proposed research designs, budgets, schedules, and expected outcomes.	Yes This may include NRA's and other selection processes
4.2.2.b Using peer review processes established in NPR 1080.1, *Science Management*, evaluate proposals based on the criteria established in the solicitation.	Yes May also use NAR's
4.2.2.c Recommend proposals for selection. Specifically, the Portfolio Manager **shall**:	See subparagraphs
(1) Review findings from peer review and other factors, and recommend selections for approval by the Selection Official.	Yes
(2) Include the rationale for selection or non-selection of each proposal evaluated.	Yes
(3) Include a description of all research activities within the portfolio including activities that are continued from previous years.	Yes
4.3 Portfolio Approval	Title
4.3.1 The MDAA (or MSOD) through the designated Selection Official **shall** review the recommendations and supporting information, and if acceptable, approve the selection of investigations for award.	Yes
4.4 Portfolio Implementation	Title
4.4.2 Requirements: The Portfolio Manager **shall**:	See subparagraphs
4.4.2.a Initiate funding for selected investigations.	Yes
4.4.2.b Update the portfolio to include the specific details of the new research investigations that have been selected.	Yes
4.4.2.c Encourage PIs to communicate their results through activities such as:	Yes
(1) Submitting progress reports (at least on an annual basis) that summarize research results to date.	Yes
(2) Publishing research results in peer-reviewed publications, participating in scientific and technical society meetings, major conferences, workshops, and carrying out other similar efforts.	Yes
4.4.2.d Maintain and report performance metrics in electronic form as required by NPR 1080.1, *Science Management*, and report it to the NASA Office of the Chief Scientist (OCS).	Yes
4.5 Portfolio Evaluation	Title
4.5.2 Requirements: Evaluation is a multi-level process in which the Portfolio Manager **shall**:	See subparagraphs
4.5.2.a Evaluate investigations within a portfolio largely during peer review following solicitation and during performance of the investigation by review of progress reports submitted by the PI during implementation.	Yes
4.5.2.b Review portfolio scope annually, describe changes in portfolio scope in solicitations, and report changes in annual evaluations.	Yes
4.5.2.c Provide information to support evaluation of portfolio performance as specified in the Program Plan.	Yes